THE SOUTH AFRICAN DENTAL JOURNAL

SADJ

MARCH 2023
Volume 78 Number 2

ISSN No. 2519-0105 – Online Edition
ISSN No. 1029-4864 – Print Edition

SADA
THE SOUTH AFRICAN
DENTAL ASSOCIATION

The baobabs of Mapungubwe

In the far nothern reaches of South Africa lie the remains of the Kingdom of Mapungubwe, a civilisation that existed in Africa in the 13th century, in amongst the sandstone cliffs, riverine forests and the ubiquitous baobab tree, many of them over 1 000 years old, with their root-like branches and wide girth that dominate this land shrouded in legend.

SADA
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AGM
Annual General Meeting

NOTICE OF 23rd ANNUAL GENERAL MEETING (AGM) OF The South African Dental Association NPC (SADA)

Notice is hereby given that the 23rd Annual General Meeting of Members (AGM) of The South African Dental Association (SADA) NPC, will be held on 22 June 2023 at 18h00, which will be held via SADA's Zoom virtual meeting

(Due to the virtual meeting, member participation will be facilitated through the Zoom platform of the meeting. To allow for the confirmation of a quorum, members are kindly requested to join the virtual meeting no later than 17h45 to avoid delaying the meeting). The Agenda with any supporting documents for the meeting will be posted on the SADA website and sent electronically to voting members.

SADA is your Association and your voice counts.

KC Makhubele
Chief Executive Officer
February 2023

THE SOUTH AFRICAN DENTAL JOURNAL
SADJ

Published by:
CREATIVE SPACE MEDIA

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Our Front Cover for this Issue...

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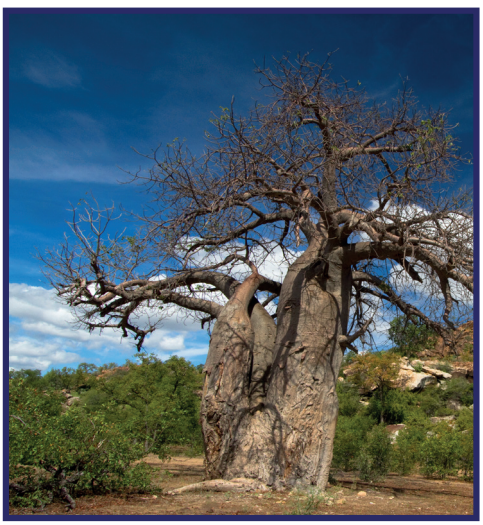

THE SOUTH AFRICAN DENTAL JOURNAL
SADJ

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Published by: CREATIVE SPACE MEDIA

On behalf of: SADA THE SOUTH AFRICAN DENTAL ASSOCIATION

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Accredited by the Department of Education SADJ is published 10 times a year by E-Doc, a Division of Pharmcom CC, on behalf of The South African Dental Association.

www.sada.co.za / SADJ Vol. 78 No.2
https://doi.org/10.17159/sadj.v78i02.16142

Is there a decline of Scientific Output in South African Dentistry: Addressing the Concerns and Nurturing Future Scientists

SADJ March 2023, Vol. 78 No.2 p61

Prof NH Wood - *BChD, DipOdont(MFP), MDent(OMP), FCD(SA), PhD*

I have received comments in general discussion with colleagues who ask me whether scientific progress in South African dentistry has declined over the last decade. Researchers and academics often point to a decline in the quantity and quality of this research, leading to concern and speculation. While there is no definitive data or statistics to support these claims, anecdotal information suggests that the quantity of dental research publications in South Africa have declined over the past few years. This decline may be due to a number of factors, including financial constraints, lack of resources, limited time available, and his recent COVID-19 pandemic, which has further strained the field. However, these are not a sufficient explanation for the decline and the dental community needs to take action to address this problem.

Dental research is essential to advancing our field and providing quality dental care. Exploring new techniques, materials and treatments allows researchers to develop and improve ways to prevent and treat dental disease. This research will contribute to the wider field of healthcare and have implications for other medical specialties. Dental research also provides a platform for training young researchers who can contribute to this field. Academics and scientists in dentistry are often, but not always, employed by provincial departments of health. It is understandable that these departments have to prioritize service delivery over research output. As a result, researchers in dentistry often report to have less time and support to conduct research, that counterparts with purely University appointments. Furthermore, dual appointments, which are common in dentistry in South Africa, can also impact on the time available to perform research.

Declining scientific output is a multifaceted problem that requires multifaceted solutions. First, we need to ensure that researchers and researchers have the resources and support they need to do their jobs effectively. Financial constraints may limit the scope of research conducted and limit access to necessary resources such as laboratory equipment and specialized software. This problem is exacerbated by limited research funding and the relatively low profile of dental research in the South African medical community.

Second, we must prioritize the education and training of young researchers, providing them with the tools and skills they need to make regular and meaningful contributions to the field. In addition to formal training, mentoring and networking opportunities are essential to the development of young researchers. These opportunities enable the exchange of knowledge and expertise, as well as the development of new ideas and research collaborations. Ultimately, the goal should be to create an environment that supports and nurtures the next generation of dental researchers.

Third, there is a need to raise awareness among both the dental community and the general public about the value and importance of dental research. Dental research should be viewed as an important aspect of health care that has a real impact on the treatment and prevention of dental disease. To achieve this, we must reach out to a wider public, conduct awareness campaigns, and emphasize the importance of dental research and its benefits to society.

Finally, we must strive to improve collaboration among researchers, scholars and practitioners, break down silos and foster a culture of openness and collaboration. Collaboration helps overcome the limitations of individual research projects and enables the development of more comprehensive and impactful research. Collaborating also helps ensure that research is relevant to the needs and concerns of dentists and patients.

In conclusion, any perceptions reflecting a decline in scientific output in South African dentistry is a cause for concern, but it also presents an opportunity for growth and development. By addressing any possible root causes of the decline and nurturing future researchers, we can ensure that dental research continues to contribute to the advancement of the field and the provision of high-quality dental care. The dental community must take action to support research and researchers, prioritize education and training, increase awareness of the value of dental research, and foster collaboration among all stakeholders.

Erratum

We wish to apologies for the errors in the article “Embracing new technology, with caution” in the February 2023 edition. The page numbering in the article is 49-51 and not 62-64 as listed above the author’s names. Figure 3 on page 51 should appear in the article on page 12. Right is the correct Figure 3. This has been corrected on the digital version: 20 April 2023.

www.sada.co.za / SADJ Vol. 78 No.2
https://doi.org/10.17159/sadj.v78i02.16140

Breaking free from medical aid rates: empowering dentists to provide high-quality dental services in South Africa

SADJ March 2023, Vol. 78 No.2 p62

Mr KC Makhubele – CEO, South African Dental Association

Dental care is vital to overall health and wellness. There is a myriad of challenges that health practitioners face when dealing with medical schemes/third-party funders. To address some of these challenges, some South African dentists accept medical aid rates for their services, to make their lives, and those of their patients' lives somewhat easier. In this piece, however, we argue that dentists in South Africa should set their own fees rather than rely on medical aid rates.

Initially, the price of dental care varies widely based on the necessary treatment. While calculating their rates, dental practices must account for rent, salaries, equipment, supplies, and other administrative expenses. Accepting medical scheme rates may not correctly reflect the actual cost of providing dental services, resulting in dentists getting less compensation than is necessary to maintain a sustainable practice.

Second, dentists' fees should be based on the value they bring to patients. Dental treatment is not a one-size-fits-all service, and prices should reflect each patient's unique needs. By determining their own fees, dentists can provide individualised treatments and high-quality care without being constrained by medical aid fees and protocols. By setting fees, medical aids are basically eroding the quality of dental care that a patient should otherwise receive.

Thirdly, reliance on medical aid rates may restrict dental care for individuals with the greatest need. The current model of scheme-determined rates flies against all logic – for similar treatment given to different patients, the pricing is based on the medical aid to which the patients belong! The various medical aid schemes have different cost covers for the same/similar treatment. It would make sense that each practitioner sets their own fees.

Fourthly, enabling dentists to set their own fees may stimulate competition and reduce the overall price of dental care. Patients can choose the greatest value for their needs and budget if more dentists offer treatments at various pricing points. This will also motivate dentists to deliver high-quality care at competitive prices to maintain market competitiveness.

As an Association, we have accepted that choosing your own fees can be challenging and occasionally unsettling as a dental professional. You want to give patients high-quality care while ensuring that your practice remains profitable. Fortunately, there are tools available to assist you to make informed judgements regarding your pricing. The SADA DCalc is one such tool that can assist you in determining the correct pricing for your services. This tool has been updated over the years to take into consideration new knowledge, relative value units and for ease of use.

The South African Dental Association (SADA) created the DCalc to equip dentists with an all-inclusive fee calculator. The calculator takes into account several individualis ed variables such as the current income of the practice, the cost of materials, rent, salaries, equipment, supplies, other administrative expenses as well as the relative value units associated with each procedure code, made up of the knowledge, skill, effort and risk involved in performing a procedure and the length of time necessary to perform that procedure. With this tool, dentists can thereby estimate the appropriate fees for their services based on a variety of practice-specific characteristics. The DCalc tool acts as a practice profitability simulator and allows the dentist to also carry out the role of a business owner by determining the practice's estimated profit or loss. By utilising the SADA DCalc, dentists may ensure that their prices accurately reflect the value of their services.

A further advantage of utilising the SADA DCalc is that it ensures patients are charged properly for dental services. Dentists can prevent overcharging people for their services by taking into account the numerous aspects that contribute to the expense of treatment. This is especially significant in South Africa, where patients may not have access to cheap dental care due to a broad range of earnings. Dentists may guarantee that all patients have access to necessary care by setting reasonable fees.

Using the SADA DCalc can also improve dentists' market competitiveness. Dentists can attract and keep patients who seek affordable, high-quality care by establishing fair and competitive fees. This can aid in the expansion of their practice and earnings over time. In a highly competitive sector such as dentistry, the flexibility to determine one's own fees can be a significant advantage.

In conclusion, dental care is essential to overall health and wellness, and every South African should have access to reasonably priced dental care. By allowing dentists to set their own fees, they can provide personalised and high-quality care, enhance access to dental services, and foster competition that can reduce the overall cost of dental care. It is time for dental practitioners in South Africa to break free from the confines of medical aid rates and select their own prices to give better treatment to their patients.

PRESS RELEASE

Millions of people suffering from oral disease across South Africa

SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

STATEMENT: **This World Oral Health Day, SADA emphasizes the need for good oral health for our physical, emotional, social and mental well-being.**

GAUTENG: **17 March 2022**

FDI World Dental Federation calls for urgent action against oral disease on World Oral Health Day, as data shows 3.5 billion people affected globally

Monday 20 March 2023 (Johannesburg, South Africa) – South Africa is facing an oral health crisis, with millions of people suffering from tooth decay, severe gum disease, tooth loss, and oral cancer, according to an inaugural report on the global oral disease burden from the World Health Organization (WHO).

Good oral health is central to breathing, eating, and speaking, and contributes to a person's overall physical and mental well-being. When an oral disease is left untreated, it can severely impact a person's health and social prospects. Sufferers are at risk of continued pain and the development of secondary diseases, social isolation, exclusion from the workforce, and reduced educational performance.

In South Africa, 41% of children aged 1-9 years and close to 28% of people aged 5 years and over experienced untreated tooth decay in deciduous and permanent teeth respectively, while nearly 25% of people aged 15 years and over experienced severe periodontal disease in 2019. The country saw 1,933 new cases of lip and oral cavity cancer in 2020.

"Oral diseases are among the biggest challenges in global health today and mainly impact the most disadvantaged people in society," said Dr Khanyi Makwakwa, South African Dental Association's FDI National Liaison Officer. "When people have access to prevention and treatment for oral diseases, it can unlock enormous health and economic benefits for their lives and society more broadly. This World Oral Health Day, it is vital that governments take the action needed to ensure everyone has access to the oral health care they need."

Oral diseases affect 3.5 billion people globally, equating to roughly 1 billion more cases than all five major non-communicable diseases (cardiovascular diseases, diabetes, chronic respiratory diseases, cancers, and mental disorders) put together. Around 75% of people suffering from oral diseases live in low- and middle-income countries.

Despite most oral diseases being preventable and treatable with cost-effective interventions, few people globally are able to access oral health services for myriad reasons, including cost and the availability of trained professionals. In South Africa, there were 1.1 dentists per 10,000 people in 2019, below the global average of 3.28 per 10,000.

This year, the 76th session of the World Health Assembly WHO will adopt the Global Oral Health Action Plan (2023-2030), which calls on governments to ensure that "80% of the global population is entitled to essential oral health care services." This would be achieved through, among other measures, countries prioritizing the integration of oral health into their national health services and ensuring there are enough trained dental health professionals.

The Plan aligns with FDI's Vision 2030: Delivering Optimal Oral Health For All and will be integral to achieving Universal Health Coverage (UHC) for oral health by 2030. Countries and stakeholders will convene at the United Nations High-Level Meeting on UHC in September this year to discuss how to reinvigorate the process toward achieving health for all.

Dr Khanyi Makwakwa said, "The upcoming high-level meeting on UHC is a tremendous opportunity for the world to take concerted action on oral health. It is critical that tackling oral diseases be central to any action plan that aims to deliver health for everyone."

For more information or to find a dentist in your area, go to https://www.sada.co.za/

Release date: 17 March 2023

www.sada.co.za / SADJ Vol. 78 No.2
https://doi.org/10.17159/sadj.v78i02.16185

Prevalence and risk factors of missed appointment among paediatric patients after minor oral surgical procedures in a tertiary hospital in Southern Nigeria

SADJ March 2023, Vol. 78 No.2 p64-67

PU Ogordi[1], EB Edetanlen[2]

ABSTRACT

Background

Missed appointments are common in paediatric dentistry, yet not many studies have explored its prevalence and associated factors.

Aim

To determine the prevalence of missed appointments and the associated factors.

Methods

This prospective study design recruited all consecutive paediatric patients that presented for minor oral surgical procedures from 1st July 2020 to 30th June 2021. Data collected was the age of patients, gender, parents' educational level, distance from the clinic, type of minor oral surgical procedures and missed appointments. Descriptive and inferential statistics were performed. Chi-square test of association was used to determine the association between study participants' age, sex, parents' educational level, the distance from the clinic, and the prevalence of missed dental appointments. Binary logistic regression was used to determine the predictors. Data was analysed using the Statistical Package of Social Science (SPSS) version 26 (IBM, Chicago, IL, USA). A p-value of less than 0.05 was considered significant.

Result

A total of 182 paediatric dental patients, age ranged from 0.5 to 16 years and with a mean age of 8.55+3.88 participated. Most (60.4%) of the patients were females and 46.2% of them were of school age. Most of the parents had a tertiary level of education and lived within 7 to 12 kilometers from the clinic. The prevalence of missed appointments was 54.9% and the most performed minor oral surgical procedure was primary tooth extraction. The relationship between age group, minor surgical procedures with missed appointments was statistically significant (P<0.05). Binary logistic regression analysis revealed that the type of surgical procedure was the only independent predictor of missed appointments (p<0.05)

Conclusion

The prevalence of missed appointments in this study is remarkably high. Although the age of the patients and the type of procedure was associated with the prevalence of missed appointment, it was only the type of surgical procedure that was a significant risk factor for missed appointment.

Keywords

Missed dental appointments, Minor oral surgical procedures, Pediatric dentistry, risk factor.

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INTRODUCTION

Contemporary management recommends that a child's first dental visit should take place within six months of the eruption of the first primary tooth but no later than 12 months of age.[1] This first appointment will include a thorough medical and dental history; an oral examination to assess the infant's risk of developing oral and dental disease as well as the provision of anticipatory guidance for the parents.[2] Whenever a child dental patient undergoes any form of treatment, a follow-up appointment is expected to be scheduled by the dentist and kept by the patient. This will allow the dentist to assess the treatment outcome, which will help in small measure, in the maintenance of good oral health. When such appointments are not honoured by the child and parent, a 'missed appointment' or a 'no show' is said to have occurred.

Missed appointments (MAs) are defined as appointments for which the patient did not show up, or did not call in to cancel or reschedule.[3] Improving treatment outcomes and dental clinic output, through well-structured practices, should be the goal of every dentist. This, however, is affected by the patient's non-attendance which is a huge problem and of concern to the healthcare providers.[4] In paediatric dental practice, children are considerably dependent on their parents; not only during their first dental

https://doi.org/10.17159/sadj.v78i02.16185

Table 1: Sociodemographic characteristics of the patients [n=182]

Variable	Category	Frequency(n)	Percentage (%)
Age group (years)	0 - < 2 (Infants)	9	4.9
	2 - < 6 (Preschool)	54	29.7
	6 - < 12 (School-age)	84	46.2
	12 -16 (Adolescent)	35	19.2
Gender	Male	72	39.6
	Female	110	60.4

visit and treatment visits but also in attending their follow-up appointment after any dental treatments including minor oral surgeries. Minor oral surgery refers to surgical procedures in and around the oral cavity that can be performed safely and comfortably under local anaesthesia and or sedation in a dental office.[5] These procedures require a short follow-up appointment period of about a few weeks.

Missed-appointment rates in the literature vary and could be as high as 80%.[6] The burden of missed appointments is a global phenomenon,[7] and has caused prolonged treatment, poor outcomes, and high treatment costs and can psychologically affect parents/guardians and the treatment providers. More so missed appointments following minor surgical procedures can lead to wound dehiscence, surgical site infections and poor wound healing since most patients failed to come for reinforcement of postoperative instructions.[8] In teaching hospitals or training facilities, opportunities are lost to provide care to the patient and to teach the students.[9] This also has a further impact on the clinical experiences and operating hours of the students.[10] Missed appointments have been reported to be influenced by several factors.[9,11,12] Socio-demographic factors associated with the MAs include sex and age.[9] More so, type of treatment, treatment delays and child behaviour management problems have also been known to be associated with MAs.[11,12] Detman and Gorzka,[13] reported that missed appointments are likely to be affected by three kinds of barriers: Personal, structural, and financial. Personal barriers include factors like attitude toward oral health care, education level, and various demographic characteristics. Structural barriers include transportation, clinic hours, and the way providers organise their services which can also impede access to appointments. Various financial barriers can also affect a patient's ability to keep appointments.

Though missed appointments have been well studied in other fields of medical specialties in Nigeria[14,15,16,17,18] it appears no studies have been done in Paediatric dentistry. Thus, the present study was conducted with the objective to determine the prevalence of MAs over a period of 1 year at the Paediatric Dental Clinic of the University of Benin Teaching Hospital and also assess the factors associated with missed appointments. It is hoped that the findings in this study will aid the paediatric dentist and oral and maxillofacial surgeon to identify and educate parents/accompanying adults on the need to honour appointments for possible reinforcement of post-operative instructions.

MATERIAL AND METHODS

This prospective cross-sectional study was conducted at the Department of Pediatric Dentistry, University of Benin Teaching Hospital, Benin City, Nigeria. All consecutive patients that presented for treatment with minor surgical procedures were recruited from 1st July 2020 to 30th June 2021. Excluded from the study were patients undergoing non-surgical procedures, and those not willing to participate in the study. After the informed consent and the minor surgical procedures were performed, the parents/guardians were instructed to bring their children/wards to the hospital for check-ups which is the routine policy of our hospital. This instruction was emphasised at the post-operative instructions session. Data collected was the age of patients, gender, parents' educational level, and distance from clinic. Other data collected was the type of minor oral surgical

Table 2: Clinical characteristics of the patients

Variable	Category	Frequency(n)	Percentage (%)
Parents' educational level	Primary	8	4.4
	Secondary	39	21.4
	Tertiary	135	74.2
Patient address and proximity to the clinic	less than 7km to the clinic	59	32.4
	Between 7km to 12km	112	61.5
	Over 12km from the clinic	11	6.0
Minor surgical procedure done	Primary tooth extraction	132	72.5
	Permanent tooth extraction	43	23.6
	Soft tissue suturing	3	1.6
	Surgical excision	2	1.1
	Modified micromarsupiliazation	1	0.5
	Frenectomy	1	0.5
Missed appointment	Yes	100	54.9
	No	82	45.1

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https://doi.org/10.17159/sadj.v78i02.16185

Table 3: Association between missed appointment and the studied variables

Variable	Missed appointment		P value
	Yes(100) n (%)	No(82) n (%)	
Age group			
Infants	5(5)	4(4.9)	0.006*
Preschool	33(33)	21(25.6)	
School-age	52(52)	32(39.0)	
Adolescent	10(10)	25(30.5)	
Gender			
Male	45(45)	27(32.9)	0.097
Female	55(55)	55(67.1)	
Parents' educational level			
Primary	5(12.8)	3(3.7)	0.120
Secondary	16(41.0)	23(28.4)	
Tertiary	80(46.2)	55(68.9)	
Patient address and proximity to the clinic			
less than 7km to the clinic	29(29.0)	30(36.6)	0.541
Between 7km to 12km	65(56.0)	47(57.3)	
Over 12km from the clinic	6(6.0)	5(6.1)	
Minor surgical procedure done			
Primary tooth extraction	87(87)	45(54.9)	0.000*
Permanent tooth extraction	13(13)	30(36.6)	
Soft tissue suturing	0(0.0)	3(3.7)	
Surgical excision	0(0.0)	2(2.4)	
Modified micromarsupiliazation	0(0.0)	1(1.2)	
Frenectomy	0(0.0)	1(1.2)	

*= significant at $p < 0.05$

procedure and missed appointment. Descriptive and inferential statistics were performed. Categorical data were summarised in percentages while continuous data was presented in range and means. Chisquare test of association was to determine association between study participants' age, sex, parents' educational level, distance from clinic, and prevalence of missed dental appointments. Binary logistic regression was used to determine the predictors. Data were analysed using the Statistical Package of Social Science (SPSS) version 26 (IBM, Chicago, IL, USA). P-value of less than 0.05 was considered significant.

RESULTS

A total of 182 paediatric dental patients were seen in the period under review. The age range of the patients was from 0.5 to 16 years and with a mean age of 8.55+3.88. Table 1 shows the demographic characteristics of the study participants. Most (60.4%) of the patients were females and 46.2% of them were of school-age. Table 2 shows the clinical characteristics of the patients. The majority (74.2%) of the parents had a tertiary level of education while most (61.5%) of them reside at a distance of between 7km and 12km from the hospital. The prevalence of missed appointments was 54.9% and the most (72.5%) performed minor oral surgical procedure was primary tooth extraction. Table 3 shows the association between missed appointmentsand the studied variables. The age of the patients and the type of minor surgical procedures were significantly associated with the prevalence of missed appointments (P<0.05). Table 4 shows the binary logistic regression analysis of associated factors with MAs. The type of minor surgical procedures was the only variable that independently predicted the odd of missed appointment. [OR=0.242; 95%C.I = 0.08-0.70, P=0.009].

DISCUSSION

The prevalence and risk factors of oral minor surgical procedures among paediatric patients in a Nigerian tertiary hospital was prospectively studied. Missed appointment is a major public health burden for both the patients and the health providers as it affect the optimum treatment outcome and ultimately the patient's quality of life.

The prevalence of minor oral surgical procedures in this study was 54.9% and this was comparable to that reported by Bhatia *et al.*,[3] which reported a prevalence of 52.0%, but higher than 32.9% and 28.0% reported by Machado *et al.*,[19] and Prabhu *et al.*[9] respectively. The probable reason for the variation in the findings may be due to the fact that the present study considered only paediatric minor surgical procedures while the previous studies looked at all paediatric dental procedures. In this study, the plan at follow-up appointment was to review the operative sites, reinforce the post-operative instructions in order to ensure proper operative site healing and also assess other risk where necessary. In the previous studies, despite having similar plan like in the present study

https://doi.org/10.17159/sadj.v78i02.16185

Table 4: Binary logistic regression analysis of associated factors with missed appointments

Variables	odd ratio	95% of odd ratio		P value
		Lower	Upper	
Age group				
Adolescent	-	-	-	.768
Infant	1.976	.266	14.566	.508
Preschool	1.003	.266	3.747	.998
School age	1.344	.407	4.402	.631
Minor surgical procedure				
Primary tooth extraction	-	-	-	-
Permanent tooth extraction	-	-	-	-
Suture related procedures	.242	.084	.697	.009*

also needed to continue with one form of treatment or the other at the follow up appointment.

There was as association between the age of the patients and the prevalence of missed appointments in the present study. However it fails to independently predict the risk of missed appointments when subjected to logistic regression analysis. This findings in our study agrees with that by Bhatia *et al.,*[3] but disagrees with Prabhu *et al.,*[9] who reported a higher MA among the preschoolers. Meanwhile, AlSadhan4and Bos *et al.,*[23] found no difference among age groups.

The type of oral minor surgical procedure was the only factor that independently predicted MA among the covariates subjected to logistic regression in the present study. Some Nigerian authors have reported tooth extraction as the most common treatment procedure carried out in the paediatric dental clinic.[24,25] The present study revealed that primary tooth extraction is the most performed paediatric minor surgical procedure and also accounts for the highest proportion of MA. The rationale behind the high proportion of MA in our study may be connected to the uneventful healing of the extraction sites following the extractions of primary teeth which are less invasive to that of the permanent teeth. It could also be due to the adherence to our post-operative instructions which would have helped to accelerate the healing of the extraction site. The paediatric minor surgical procedures in our study with absolutely no MAs included procedures that were suture related and it accounted as a predictive factor responsible for not missing an appointment. The reason for this finding could be due the presence of a foreign substance, like the suture material in the oral cavity, which must have propelled the patient to honour the appointment.

In this study, the limitation was that it only focused on patients that had only minor oral surgical procedures and there is need for further study to assess with all paediatric dental treatment procedures. Furthermore, the findings of this study should be interpreted with caution since it is a single centre study as there may be need for multicentre study in future.

CONCLUSION

The prevalence of missed appointments in this study is remarkably high. Although the age of the patients and the type of procedure was associated with prevalence of missed appointments, it was only the type of procedure that was a significant risk factor of missed appointment.

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www.sada.co.za / SADJ Vol. 78 No.2
https://doi.org/10.17159/sadj.v78i02.16186

Perceptions of oral health practitioners regarding the long-term effects of service learning; a qualitative study

SADJ March 2023, Vol. 78 No.2 P68-73

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ABSTRACT

Introduction

The long-term effects of service learning (SL) have not been explored in the oral health field. Such information has the potential to provide useful feedback to dental educators regarding the effectiveness and impact of SL. This would be relevant in the South African context of inequality and poor access to care.

Aim and objective

To explore the perceptions of oral health professionals from an academic institution regarding the long-term effects of SL.

Methods

A case study design was used. Semi-structured interviews were conducted. A total of 22 participants from the Bachelor of Dental Therapy, Bachelor of Dental Surgery, and Bachelor of Oral Hygiene participated in the study.

Results

The participants indicated that SL is a worthy activity that exposed them to the real world of dentistry and provided them with the exposure that prepared them for work actualities. Four major themes emerged; namely, personal qualities, relationship building, challenges related to SL and strategies to improve the outcomes.

Conclusion

Participants found SL to be beneficial in their professional development and practice although they highlighted some challenges in practice. They recommended the improvement and upgrading of the SL program, as well as further research on SL approaches in other environments.

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Keywords

Service Learning, Community Engagements, Perceptions, Academic Enhancement, Civic Responsibility, Interpersonal Skills, and Learning.

INTRODUCTION

The benefits of Service Learning (SL) in Dental Education are well-known. Evaluations of SL are generally based on the experiences and opinions of undergraduate students. Unfortunately, the views of dental graduates and working dentists regarding their SL experience in dental school remain relatively unexplored. Such information has the potential to provide useful feedback to dental educators regarding the effectiveness and impact of SL. This would be especially relevant in the South African context of inequality and a lack of access to care for large parts of the population.

SL, according to several authors[1,2] may be unpacked as an educational approach that combines learning objectives with community service in order to enable students at an early stage of their academic development to provide/improve services to communities in areas where governments fail to serve, and provide a pragmatic, progressive learning experience while meeting societal needs.

Community-based education (CBE) on the other hand is "field-based experiential learning" with community partners as an instructional strategy. CBE is part of the work-integrated learning (WIL) approaches such as SL. The idea is to give students direct experience with issues they are studying in the curriculum and with ongoing efforts to analyse and solve problems in the community. A key element in these programs is the opportunity for students to apply what they are learning in real-world settings and reflect in a classroom setting on their service experiences. These programs model the idea that giving something back to the community is an important University outcome, and that working with community partners is good preparation for citizenship, work, and life.[3] Similar benefits were reported in a four-year study conducted at the dental Academy of the University of Portsmouth, London where students` responses to the CBE were evaluated. The findings included quality, more understanding, self-confidence, and personal growth. Furthermore, students felt empowered due to the autonomy granted during training.[4] The learning is usually guided by using various models for structured reflections like the Gibb`s (1988) model.[5] Self-reflection is a cognitive process as part of self-regulation whereby a learner reviews current world views and or performance in order to adapt to a more progressive standpoint or execution.[6]

https://doi.org/10.17159/sadj.v78i02.16186

It is generally assumed that oral health students who undergo SL as a teaching approach during their undergraduate training will develop many other skills like social responsibility, teamwork, communication, problem-solving, emotional intelligence, maturity, and personal growth as well as civic responsibility by connecting academic content and clinical experiences.[7,8] These connections bring about academic enhancement among the students, as well as further strengthening SL skills.[9] These skills may also be viewed as matching the 'market' demands and increasing opportunities for employment in the country.[10]

Skills acquired include interdisciplinary thinking and collaborations with colleagues, improved interactions, and positive attitudes towards serving the underserved communities.[11] Students have been found to value outreach educational experiences, particularly when they are afforded certain responsibilities. Confidence levels get uplifted, and a sense of professional development ensues.[4,12] As it occurs in other parts of the globe, Higher Education Institution (HEI) in Australia send their students to a SL excursion where they stay in the community for two weeks to get the true feel of a rural environment.[13] Students reported that their lives changed. They developed empathetic skills, endurance and resilience, patient communication as well as the heart to help the poor. According to Postma *et al,*. social responsibility and a desire to serve under-privileged communities are prominent outcomes of SL as reported by final year oral healthcare students.[14] SL in the rural settings proved to bring about pleasant outcomes to communities.

Studies conducted in South Africa, confirm the above elements as contributing to the benefits that SL offers to student learning. In agreement with several countries, Bhayat, Vergotine, Yengopal, and Rudolph (2011) allude to the fact that both medical and dental training benefit from SL.[15] The University of Witwatersrand has been sending oral health students to the Phelophepa Health Train as well as other Public Oral Health Facilities (POHF) on SL trips. The Phelophepa Health Train is a mobile Primary Health Care (PHC) facility offering Oral Health, Pharmacy, Nursing, Diet, Speech Language and Audiology, and Medical services to rural communities next to designated train stations. HEIs send students from the above disciplines to do SL.

The findings of a South African study conducted among final-year oral health students to determine their SL experiences between 2008 and 2009 revealed that there was improved efficiency in clinical skills, self-awareness and awareness of the community needs and social responsibility. Challenges that these students experienced included strenuous and long working hours as well as non-functional equipment. Gaines-Hanks and Grayman (2009) also conducted a study where they found that SL increased awareness, relational and professional growth as well as increased gratitude among students.[16] Postma *et al,*. in 2016 piloted a Community Service Attitudes Scale on the final year oral health students at Sefako Makgatho Health Science University (SMU), where students displayed a positive attitude towards serving destitute communities after exposure to SL.[14] The participants also suggested a need for relevant stakeholders to get involved in the procurement of SL resources and in meeting community needs. The impeding challenge was a quota-driven dental training.

Although the local studies provide valuable information in the local context, evaluations were focused on undergraduate students' perceptions only. Almost all studies conducted both locally and internationally evaluate perceptions of students towards SL, but we have not found any studies that have followed-up on these students after graduation as professionals in practice, that evaluate the perceptions of oral health professionals regarding how they applied the knowledge and skills acquired during oral health academic training. These South African studies have therefore highlighted the need to further investigate the usefulness of SL in oral health practice. Therefore, in this study we aim to further explore the long-term influence of SL on oral healthcare professionals, to gain a better understanding of how SL experienced during undergraduate training may develop social responsiveness of practitioners beyond graduation.

METHODS

This was an exploratory study that was conducted within a phenomenological qualitative approach. Twenty-two participants were included in the study, which comprised BDS (Dentistry), BDent Ther (Dental Therapy) and BOH (Oral Hygiene) degree program graduates of a South African University in Gauteng Province.

Semi-structured two-part interviews were administered using either face-to-face or telephonic conversations, depending on feasibility. Questions elicited participants` lived experiences during SL. An interview schedule was developed from questions that were adopted from Shiarella, McCarthy & Tucker, (2000) and Boysen, Salsbury, Derby, & Lawrence, (2016).[17,18] The first part consisted of socio-demographic characteristics. The second part captured their experiences regarding the influence of SL during their undergraduate practice as students, before, during and after the placement at the SL projects sites, as well as the impact in post-graduate practice. The information on the interview guide covered theoretical aspects, reflections, detailed information on the SL domains of social responsibility, academic development (which included problem-solving skills) and personal growth (which included interpersonal and leadership skills). English language as the *lingua-franca* was used. The completed records of participants were filed away before the interviews. The audio recorded data are kept safe on university premises, and the data will be kept for five years.

Thematic Content Analysis was used.[19] Data were analysed by creating codes. To ensure a robust process of data interpretation, numerical codes were allocated. Interrelated themes were combined to form categories and themes as detailed in the next section. Permission to conduct the study was granted by the research ethics committee of SU, HREC Reference # S18/05/102.

RESULTS

Demographic characteristics of the participants.

Most participants were between 21 and 25 years old (41%), with the fewest being between 31 and 35 years old (9.1%). There were more females than males (68.2%) and vast majority were from the African race (91%). Just above two-thirds (77%) were residing in urban areas. Most participants were oral hygienists (BOH – 41%) and 68% had completed their community service Table 1.

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https://doi.org/10.17159/sadj.v78i02.16186

Table I Characteristics of participants

Variables	Categories	N	%
Age	21-25	9	41%
	26-30	8	36%
	31-35	2	9%
	36-39	0	0%
	40yrs +	3	14%
Gender	F	15	68%
	M	7	32%
Race	Africans	20	91%
	Whites	1	5%
	Coloured	1	5%
Residence	Urban	17	77%
	Rural	5	23%
Qualification	BOH	9	41%
	BDT	5	23%
	BDS	8	36%
Year of qualification	2015	6	27%
	2016	8	36%
	2017	8	36%
Community service	Yes	7	32%
	No	15	68%

Four major themes emerged in the analysis of data in the study. These are personal qualities, relationship building, challenges related to SL and strategies to improve the outcomes. Themes were further divided into sub-themes. A summary of each theme is presented below. Sub-themes that emerged under personal qualities are personal attributes, self-reflection, character-building, psychological reward, and cultural conscientization.

Theme 1: Personal Qualities

Participants reported experiencing collegial dialogue, which precipitated into professional self-realization, and further ramifications such as maturity, empathy, compassion, humility, emotional intelligence, cultural sensitivity, and on-the-job reward and motivation. Six minor sub-themes emerged under this sub-theme. From a refreshing experience participants enjoyed a sense of professionalism and open-mindedness with which they could improve communication by confidently building rapport with each other, and with community members and faculty. Social constructivism of learning succeeded. They refined clinical skills and were also able to execute independence in decision-making related to the exigencies of their duties and this facilitated efficiency in service delivery. Other profits included: academic and intellectual achievement, positive self-esteem, improved communication, patience, and time management skills.

Theme 2: Building Relationships

Over and above personal attributes that participants reported to have gained during SL, they also expressed that SL is important in building workable relationships that bring about solutions to students, faculty, and communities.

Participants therefore said that SL exposed them to human service in that they became more aware of community needs, became socially accountable to create public awareness regarding oral health problems in communities, which would bring the most needed access to services. They felt morally obliged to plough back and SL became their roadmap to their current practice.

Table 2 The themes in a summary form, linking with the objectives of the study

Objectives	Themes	Subthemes (number of participants)
Q1, Q3	**Theme 1** Personal Qualities	Personal attributes (8) Community as an educator (1) Enhanced professional skills (9)
Q1, Q2, Q4	**Theme 2** Building Relationships	Student community collaborations (18) Awareness of community needs (4) Social accountability (10) Holistic approach (2)
Q1, Q4, Q5	**Theme 3** SL Challenges	Private practice-related challenges (2) Community-related challenges (7) SL Curriculum challenges (9) Quality of care challenges (6) Stakeholder/role player-related challenges (3)
Q1, Q2, Q3, Q4, Q5	**Theme 4** Strategies to improve SL outcomes	Request for longitudinal SL program (7) Curriculum review (10) Improve infrastructure and equipment (1) Introduce inter-professional working relationships among students (2) Act on student feedback (1) Monitoring and evaluation of SL in the community (2)

The table above is a brief demonstration that the research purpose was addressed by showing how and where the study objectives have been attained.

https://doi.org/10.17159/sadj.v78i02.16186

Theme 3: Challenges

Despite all the good that participants reported about SL however, there were also challenges such as poor planning at SMU School of Oral Health Sciences that rendered the program to appear insufficient in some areas. These inadequacies manifested in the following ten sub-themes: less challenging theory, communities' lack of knowledge, limited resources impeding quality of oral health services, unfair assessment of reflective essays, dissatisfaction with political rhetoric coupled with lack of political will to prioritize oral health, lack of professionalism by supervisors, restrictive exposure to patient category and care, lack of follow-up in the curriculum and bloated final year syllabus.

Theme 4: Strategies to Improve Outcomes

Due to the above departmental and community frustrations around SL, participants therefore recommended some upgrading such as SL theory to be reduced and replaced by community work. Many recommended that SL needs to be expanded to local communities, to other departments and disciplines, as well as to introduce it earlier in the academic programme. All 22 participants supported SL approach, but expressed implementation of the following strategies: Expansion of SL to other communities (inside and outside campus) and programs, inclusion of current socio-political issues in the SL curriculum, increase of SL opportunities and introduction of the credit system, maximising the student outreach opportunities, evaluation of treatments in the communities, increase of the number of mobile clinics, inclusion of patient follow-up in the SL curriculum, gradual and simultaneous introduction of theory and practical, increased treatment packages, inclusivity of learning styles during reflections, introduction of video clips during community engagements, prompt student feedback, making SL fun and fashionable, introducing student reflections earlier in the dental program and introduction of inter-professional working relationships among students.

DISCUSSION

This study sought to obtain the views of qualified professionals regarding their SL experience at SMU and is the first of its kind in Dentistry in South Africa. Generally, participants agreed to the benefits of SL in their personal capacities, professional life, and in building relationships with one another, with faculty as well as with communities. However, there were some drawbacks in the sense that some practitioners perceived SL as an unknown and unsupported approach. They complained that a good approach such as SL cannot be applied in one University Department such as Community Dentistry, but needs to be expanded to other departments, faculties, and facilities in the community. Some mentioned that political corruption affects oral healthcare in a bad way. Although our study identified some gaps in SL, it is in line with other studies that reported the positive contributions of SL such as developing social responsibility, teamwork, communication, problem-solving, emotional intelligence, maturity, and personal growth as well as civic responsibility by connecting academic content and clinical experiences.[7-10] Participants therefore came up with recommendations to deal with problems that they perceived as stumbling blocks to SL benefits. In addition, time pressures of the curriculum factored a lot in their dissatisfaction and recommendations.

Like other studies, the participants asserted that SL had a positive influence on their personal development as well as in their career practice as oral health professionals.[7-10] They view SL as a mechanism for self-reflection, through which a humble character is built. Their new character empowered them to view communities with compassion and sensitivity to different cultures. From these communities they acquired a holistic perspective in their career, integrating the technical/academic skills with the essential skills for clinical practice that are needed when actual practice takes place. They also indicated to have experienced SL as a pleasurable learning occasion. The exposure to communities and learning to handle them according to their needs and problems beyond the oral health related ones (dental box), seem to have enabled and assisted the professionals to approach the treatment in a more caring way.

The study participants also attested to more added values of SL confidence regarding the management of anxious patients (those who fear the treatment), as well as the children who come for treatment. Further to the above the graduates' general perception about exposure yielded a view that this apprenticeship-cum-induction contributed immensely to their self-concept as practitioners. This is in agreement with other studies that reported SL beneficial in improving patient management skills.[7, 8, 14, 15] The SL exposure enabled the oral health professionals to invest in people's trust by giving best services and encouraged return services and word-of-mouth referrals. The SL-trained oral health practitioners, together with their clients/patients, were also led to an enjoyable service provision because of SL guidance. These professionals' goal was to satisfy the clients under treatment, and moreover, to provide services that could be appreciated, and this was confirmed by the reported excitement of their clients. This approach was also experienced as a connection, linking theory with practice as those trained were able to manage actual work in the field of practice; to understand people more, and to have a desire to assist patients, especially where and when they are needed.

While the main training of the health professionals was in oral health, SL extends to enabling relationships between professionals and communities. It also creates a platform for the experts to empower community members as stated by one of the participants: "Yes, you can't beat yourself to it but at least you have tried, and you are aware of certain situations in the community". It is through the connection, trust, and confidence of the professionals that they can enlighten the community members about oral health treatment and clear some myths among communities. Similar to other studies that reported positive clinical and social outcomes in the community,[11,14] the trust was also viewed in our study as enhancing the relationships with people where good rapport would exist between oral practitioners and their patients, hence participants felt morally obliged to assist the community. However, some studies cited the fact that SL being quota-driven, poses a challenge because students tend to focus on completing quota rather than acquiring quality skills.[14]

Other challenges related to SL were indicated though, as limited training time, limited coverage of communities, inadequate supervision, price limitations (in some instances), poor timing of SL and unfulfilled promises. The participants complained that the duration of SL is very short and denied them adequate exposure because it ends when they start realising the actualities of oral health practice; it blocks

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actual treatment of patients and prevents perfection as it ends before leading to mastery. The communities visited during SL training are the same every year and are few. This means that exposure does not expand the various groups engaged in SL to varieties of conditions. There was also a complaint about lack of supervision as the trainees are placed alone in the actual work environment and required to make decisions independently, without any experienced professional showing different options and scenarios. Some SL trained oral health practitioners confessed to providing service only to the level that suited the price paid (though only a few occasions). This was a weakness, since even one failure was considered lack of success. The fact that SL takes place only in the final year was viewed as a loss of opportunity for more learning as earlier student years are starved of the reality that could be used to expose the trainees much earlier to actualities of their professions. This could also perfect their skills towards mastery as they would have gone for many years on the SL. The issue of empty promises in which previous SL trainees had indicated to return to treat community members in need, haunted the subsequent SL groups, as they were being blamed for current state. However, the same groups who felt unfairly blamed, seem to have continued the same mistakes of promising without fulfilment.

The weaknesses identified and the desire to provide best practice of SL to the oral health practitioners led to proposals to improve the SL training. There was also a suggestion that while the public sector was receiving support from government, this sector should also be supported equally to ensure that even the communities without government health facilities can benefit from the support.

The findings of this research are quite crucial in improving the SL delivery model. Oral health practitioners can reflect on the SL intentions and adapt their attitudes and practice, especially those who were focused mostly on making profit and lowering service where payments were not adequate. On the other hand, curriculum experts in the relevant departments can also incorporate the suggested proposals in order to improve the SL model in SMU.

In addition, the study was a form of action research, which, according to McNiff (2013), may be defined as research either initiated to solve an immediate problem or a reflective process of progressive-problem-solving managed by individuals working with others in teams.[20] This could also work as a component of a community practice aimed at improving the way issues and problems are being addressed. This study was practical in the sense that it managed to confront problems existing in the SL training. It also identified problems that could be resolved and on the verge of producing guidelines for effective practices in the form of recommendations. The problems adjusted can be addressed in different timeframes such as short-term and long-term. Short-term solutions could be implemented by sending oral health students to the SL sites for observation, while ensuring that arrangements are made for future curriculum to integrate SL from earlier years.

CONCLUSION

Participants found SL to be beneficial in their professional development and practices. They pointed out that they appreciated the members of communities and assisted where the communities were unable to pay for their services. They also indicated that they went beyond oral health treatment in some cases, especially after familiarising themselves with the problems and challenges that the communities and the families were experiencing and had to endure. There were still few practitioners who did not fully embrace or appreciate providing full service when money from clients was limited, and thus provided a service that suited the amount of money paid; this is the implied prescription by the current capitalistic system in healthcare. The participants indicated that the academic side of their training was only theory, and that SL was handy in bringing the practical perspective which made them understand the oral practice requirements of their qualifications even better. The challenges in the communities and the real work situation were not reflected anywhere in the academic learning of oral health, but SL was said to have provided that component to an inclusive extent. Furthermore, the SL as offered, beneficial as it was indicated, had limitations of timing and duration, as well as limited coverage to communities. These findings may be useful to adjust and standardize the curriculum at SMU and at all other Oral Health Faculties.

RECOMMENDATIONS

The participants indicated that the academic side of their training was reinforced by SL practice in the community. They emphasized that SL content would be efficient in all respects if it was properly delivered. They also said that SL was convenient in bringing a practical perspective, which made them understand the oral practice requirements of their qualifications. The strengths of SL offered at SMU should be researched qualitatively in a separate study. There should be benchmarking research undertaken by leading higher education institutions. Comparative in-depth studies should be undertaken to determine the areas, which are not adding value to the current SL in SMU in order to ensure that they are removed before any incorporation into the revised curriculum, and SMU should involve community partners in the continual evaluation of the pedagogy as a mission to improve the SL program and the educational experience for the students.

ACKNOWLEDGMENTS

We acknowledge Dr Lakshini Sandhya McNamee and my co-supervisor Prof. Thomas Corne Postma, for their supervision, continued support, dedication, and tireless commitment, to this work.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

MGP was involved in conceptualization, data collection, data analysis, and manuscript preparation. PS and BM were involved in the manuscript preparation.

FUNDING SOURCES

This research was funded by MGP through the Research Development Grant (RGD) by DHET from 2016-2019.

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Online CPD in 6 Easy Steps

The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

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https://doi.org/10.17159/sadj.v78i02.16187

Supernumerary teeth in a sample of South African dental patients

SADJ March 2023, Vol. 78 No.2 P74-81

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ABSTRACT

Introduction

Supernumerary teeth (SNT) are often associated with malocclusions. Data on SNT in the South African population are not well documented.

Objective

To determine the prevalence, distribution of characteristics and any associated complications of SNT in a South African sample of dental patients.

Design

The study was retrospective, cross-sectional and descriptive. Method: Orthopantomographs of 12,005 dental patients were reviewed for the presence of SNT. The number, morphology, location, eruption status and orientation of SNT were assessed. Associated orthodontic problems were noted.

Results

The prevalence rate was 2.48%. No sexual dimorphism in the distribution of SNT was noted. Types of SNT tabulated were: supplementary, conical, tuberculate and odontoma. Maxilla demonstrated a higher predilection for SNT. Variation in the distribution of SNT in the anterior, premolar and molar regions in each jaw and across jaws was statistically significant. Relationship of eruption status to the morphology and orientation of SNT was of significance. Malocclusions noted were displacement and impaction of adjacent teeth.

Conclusion

From an orthodontic perspective, presence of SNT may compromise tooth movement and space closure in patients. Additionally, as majority of SNT in this population were in the maxillary molar and mandibular premolar regions, caution is advised when planning the placement of orthodontic implants in these regions.

Keywords

Supernumerary tooth, panoramic radiographs, prevalence, morphology, location, eruption status, orientation, orthodontic complications.

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Acknowledgements

1. The corresponding author would like to thank Prof MPS Sethusa, Head, Department of Orthodontics, School of Oral Health Sciences, Sefako Makgatho Health Sciences University for his support and encouragement during the entire duration of this study.
2. The authors would like to acknowledge Ms Ciska van der Schoor for her technical assistance, supported by the Bakeng se Afrika project 597924-EPP-1-2018-1-ZA-EPPKA2-CBHE-JP, an Erasmus+ programme of the EU.

INTRODUCTION

Supernumerary teeth (SNT) are defined as teeth in excess of the normal dental complement (more than 32 permanent teeth or more than 20 primary teeth),[1] and present as developmental anomalies that may be responsible for malocclusion in an individual. Many theories have been put forward to explain this developmental abnormality, including atavism (evolutionary throwback), hyperactivity of the dental lamina, tooth germ dichotomy, and genetic and environmental factors.[2] Knowledge about the prevalence, characteristics and effects of SNT in a given population helps clinicians to improve their diagnostic acumen and efficiently streamline treatment strategies.

Supernumerary teeth (SNT) can occur singly or in multiples, unilaterally or bilaterally, erupted or unerupted and within a single jaw or in both jaws.[3] SNT are classified according to their morphology as either conical, supplemental, tuberculate, or as an odontoma.[4,5]

Conical supernumerary teeth are peg-shaped small teeth with root development concurrent or ahead of the adjacent permanent teeth. The most common type of conical SNT, found between the central incisors in the premaxillary region and known as the mesiodens, may cause many orthodontic problems such as displacement, rotation or impaction of adjacent teeth.[6,7]

Supplemental SNT are usually found at the end of a tooth series as duplications of teeth in the normal dentition. The most common type of supplemental SNT is the maxillary lateral incisor. Additionally, supplemental premolars and molars have also been reported.[8,9] In some cases, these

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supplemental premolars and molars develop after the formation of the permanent dentition and are thought to be representative of a third dentition.[2]

Tuberculate SNT are large and barrel-shaped with multiple cusps or tubercles. The root development is delayed when compared with adjacent teeth. They are mostly found unerupted in the palatal aspect of the maxillary central incisors and are known to cause impaction of those teeth.[10] Odontomas are described as an additional category of SNT.[4,5] An odontoma is usually considered to be a hamartomatous malformation of enamel, dentin, cementum and pulpal tissue, rather than a neoplasm. Odontomas rarely erupt into the oral cavity.[11]

Not only the morphology but also the orientation of SNT appear to play a role in their eruption.[10] It was noted that approximately 25% of SNT erupt into the oral cavity while the rest remain unerupted.[11] Regardless of their eruption status, supernumerary teeth may be associated with many complications such as spacing, ectopic eruption and/or root resorption of adjacent teeth, formation of pathologic cysts, or root dilacerations.[4,5,12,13] Conversely, SNT may remain asymptomatic without any clinical manifestations and are often discovered by chance during a routine radiographic examination.[10]

A literature survey disclosed a paucity of data on SNT in the South African population. A publication that could have some relevance in this topic was that of Van der Merwe and Steyn[14] who reported on the incidence of SNT in the skeletal remains of a 19th-century mining community from Kimberley, South Africa. Historical and standard anthropometric records indicated that these were predominantly male migrant workers suffering from a myriad of medical conditions and traumatic injuries who had died around 1897 and 1900 and were given pauper burials outside the fenced-off Gladstone cemetery in Kimberley. It is noteworthy that not a single individual in the Gladstone cemetery sample presented with the commonly observed anterior SNT.

The study of Van der Merwe and Steyn[14] on their limited (n=89) and more than a century-old, sample, demonstrated a distribution pattern of SNT atypical to what has previously been reported.[5,6,7] Anecdotal and unpublished observations by clinicians of patients in various hospitals in the Gauteng province of South Africa further support the view that the distribution of SNT in this population group follow a different pattern. The observations indicated that whilst SNT were often noted in the posterior regions, they also occurred in the premaxilla.

The aim of this study, therefore, was to determine the prevalence, characteristics and effects of SNT in South African dental patients. The district hospital where this study was conducted is one of the three main government hospitals that cater for the dental needs of the general South African population. Therefore, the sample drawn from this pool may be considered representative of the local dental population inhabiting north-western Gauteng and the adjacent Northwest province. The results of this

Table I: Listing, classification and descriptions of supernumerary teeth characteristics

Characteristic	Classification	Description
1. Number of SNT		The absolute number of SNT present in the female and the male samples
2. Morphology of the SNT [4,5]	Supplemental	Resembling the adjacent non-affected permanent teeth
	Conical	Conical in shape and may have a normal sized root
	Tuberculate	Short and broad with a crown that appears normal and a root that is rudimentary or invaginated
	Odontoma	No regular shape
3. Regions within the mandible/ maxilla	Anterior	Extending from the distal surface of one permanent canine to the distal surface of the canine on the contralateral side.
	Premolar	Extending from the mesial side of the first premolar to the distal side of the second premolar
	Molar	Extending from the mesial side of the first molar and beyond.
4. Eruption status of the SNT	Erupted	Crown has emerged past the alveolus
	Unerupted	Crown housed within the alveolus
5. Orientation	Vertical:	The orientation was akin to the vertical orientation found in normally erupted teeth
	Inverted:	The crown of the SNT presented in an inverted manner
	Oblique:	The long axis of the tooth departed from the normal vertical orientation of teeth
	Other:	The long axis of the SNT is not discernible
6. Dental problems directly caused by the presence of SNT	No effect	Arrangement of dentition not affected by the presence of SNT
	Displacement of adjacent teeth	Presence of crowding, rotation or abnormal axial inclination
	Spacing of adjacent teeth	Loss of contact points between adjacent teeth
	Impaction of teeth	Adjacent teeth are prevented from erupting due to the presence of SNT in the eruption pathway
	Any other effect on adjacent teeth	Formation of cysts, resorption of teeth

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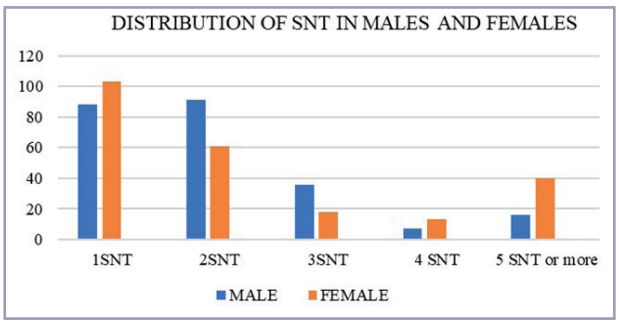


Figure 1: Distribution of the number of SNT within patients by sex.

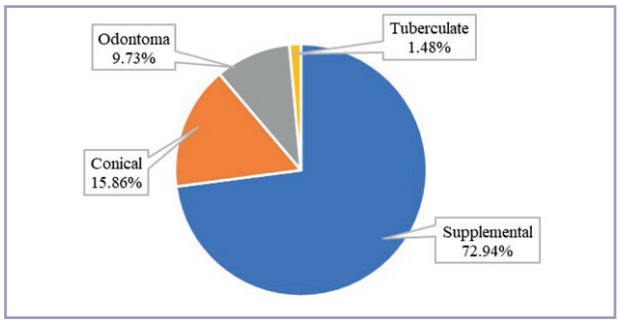


Figure 2: Percentage distribution of the various morphological characteristics of SNT

study may alert clinicians to the possible presence of SNT and influence the diagnosis and treatment planning of affected individuals. The data may contribute to future research projects on the phenomenon.

MATERIALS AND METHOD

SNT were assessed using panoramic radiographs, a standard diagnostic radiographic tool used at the tertiary general dental hospital in the Gauteng province where this study was conducted. The orthopantomographic method of assessing SNT was chosen because the majority of SNT fail to erupt and may not cause any dental problems in affected individuals and are often discovered as an incidental pathologic finding in initial diagnostic radiographs of patients presenting with an entirely different chief complaint.

Panoramic radiographs of South African dental patients who had presented for general dental treatment during the time interval December 2018 to July 2020, were scrutinised for the presence of SNT. The inclusion criteria for the sample were as follows: 1) good quality panoramic radiographs, clearly portraying the dentition and adjoining structures, and 2) the age range of the subjects ranging from the first decade to the fourth decade of life. Exclusion criteria were: 1) radiographs of patients with syndromes that exhibited a known predilection to SNT e.g. cleft lip and palate; an exclusion criteria that was followed to get a true representation of the prevalence of SNT in this study population and a protocol supported in other epidemiological studies of SNT[1,3,15,16] and 2) individuals without the full complement of teeth expected at their respective ages. The patient's hospital files were evaluated to ensure that the inclusion/exclusion criteria were met. Overall, 12,005 panoramic radiographs of patients were screened. A total of 298 patients with 473 SNT were catalogued.

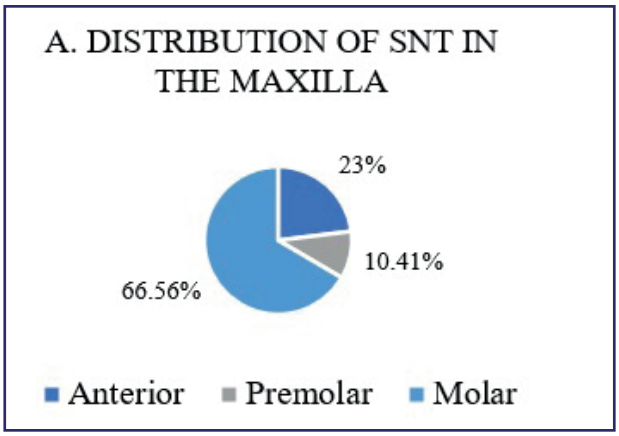
The prevalence of SNT in the sample was determined by noting the number of individuals affected by this anomaly. Associated variables such as the number of SNT, the morphology of SNT, distribution in males and females of the selected population, the affected jaw and region, the eruption status, morphology of SNT, relationship between morphological characteristics and the orientation of SNT to eruption status, as well as any complications associated with the presence of SNT, were also recorded, as listed and described (where needed) in Table I.

Statistical analysis of the data was performed using the Stata Release 16 package (Copyright 1985-2019, StataCorp, Texas, USA). Pearson's chi-square test was utilised to compare categories of one variable with respect to the distribution over the categories of a second variable. Differences between variables were assessed using Pearson's chi-squared test at the 0.05 level of confidence. Patients signed a pre-treatment disclaimer consenting to the use of their records for research purposes.

This study was approved by the Research Ethics Committee of the Sefako Makgatho Health Sciences University (SMUREC/D/306/2018) and was conducted following the Declaration of Helsinki principles. The study design was retrospective and cross-sectional in nature.

RESULTS

A total of 298 patients with 473 SNT were catalogued. The prevalence of SNT in this sample population was 2.48% (298/12005) with a 95% confidence interval (2.21%; 2.78%). For practical purposes, the gender distribution of patients presenting with this anomaly was equal (50.32% males and 49.68% females).



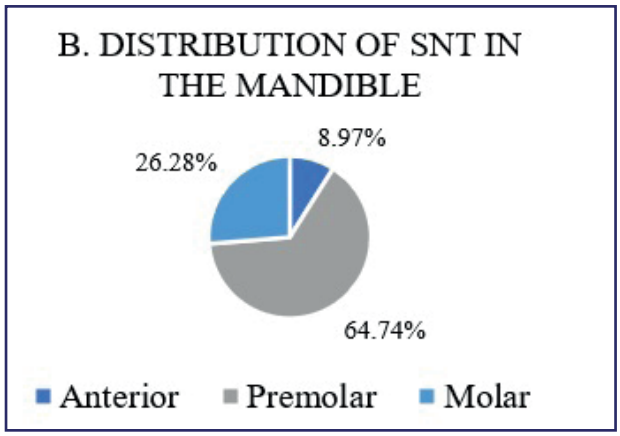


Figure 3: Distribution of SNT in the (A) maxilla and (B) mandible.

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Table II: Distribution of SNT in anterior, premolar and molar regions

Region	Number of SNT in Maxilla	% of Maxillary SNT	Number of SNT in Mandible (n= 317)	% of Mandibular SNT (n= 156)
Anterior (n=87)	73 (83.91%)	23.03	14 (16.09%)	8.97
Premolar (n=134)	33 (24.63%)	10.41	101 (75.37%)	64.74
Molar (n= 252)	211 (83.73%)	66.56	41 (16.27%)	26.28
All (n= 473)	317 (67.02%)	100	156 (32.98%)	100

Males and females did not differ significantly (p=0.1265) concerning the distribution of the number of SNT (1,2,3,4, 5 or more SNT) as illustrated in Figure 1.

Supplemental morphology was found to be the most common type of SNT (72.94%). SNT with conical morphology accounted for 15.86% of cases. The tuberculate variety of SNT (1.48%) was the most uncommon. All SNT cases that did not fall into the above three categories were grouped into the category: Odontoma, which accounted for 9.73% of the total sample. Figure 2 displays the morphological distribution of SNT in this study sample.

The distribution of SNT of varying morphology in both sexes was investigated. A design-based analysis which took into consideration that an individual within the sample may present with single or multiple numbers of SNT with varying morphology, revealed that the distributions of SNT with different morphologies in males and females were not statistically significant (p=0.9158).

The variance in the location of SNT in each jaw was also investigated. It was found that the upper jaw presented with a higher incidence of SNT when compared with the lower jaw; Maxilla: 317 vs Mandible: 156.

The distributions of SNT differed statistically significantly (p=0.0000) with regard to the various locations within each jaw (see Figure 3). In the maxilla, the molar region had the highest number of SNT (66.56%) followed by the anterior region (23%). The maxillary premolar region recorded the lowest number of SNT (10.41%). In the mandible, this distribution pattern was altered with the premolar region recording the highest number of SNT (64.74%), followed by the molar region (26.28%). The anterior region recorded the lowest number of SNT (8.97%).

The distribution of SNT also varied statistically significantly (p=0.0000) according to the various regions (see Table II). In the anterior region, the maxillary jaw (83.91%) presented with an increased number of SNT when compared with the mandible (16.09%).

In the premolar region, this condition was reversed with the mandible (75.37%) demonstrating a higher percentage of SNT than the maxilla (24.63%). The presence of SNT was again higher in the region of the molar teeth in the upper jaw (83.73%) when compared with the same region in the lower jaw (16.27%).

Only 27% of the SNT in this sample had erupted into the oral cavity. The relationship between the morphology of SNT and the variation in eruption status was explored (see Figure 4) and yielded significant results (p=0.0000). When the morphologies of the erupted SNT versus non-erupted SNT were examined, it was found that 69.53% of the erupted SNT were of the supplementary type. The conical type accounted for 25%, while the tuberculate and SNT of indeterminate shape (category: odontoma) combined, made up the remaining 5.47%.

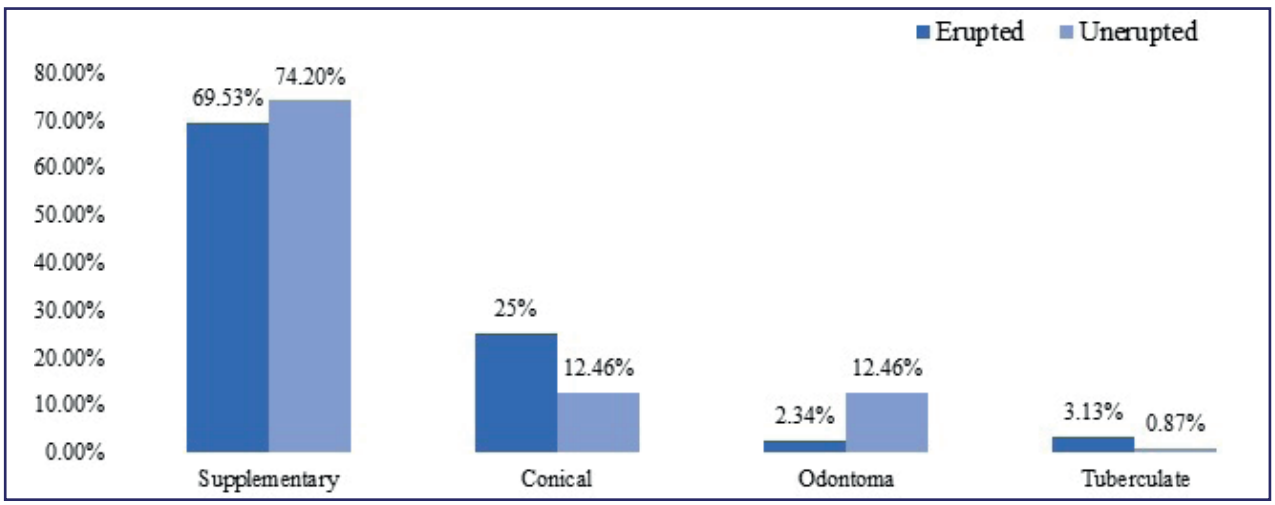

Figure 4: Morphology versus eruption status of SNT

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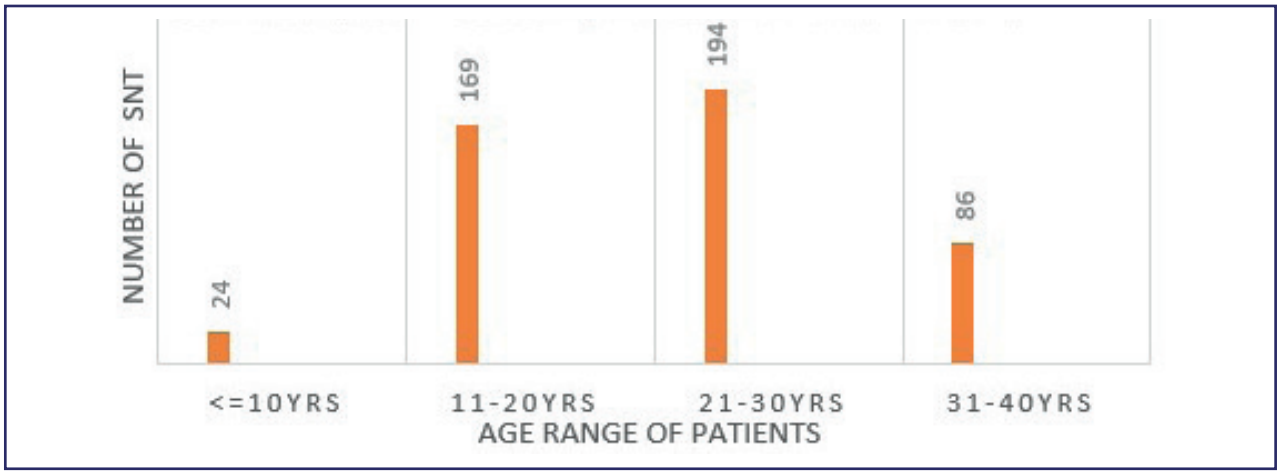

Figure 5: Age ranges of subjects versus frequency of SNT

The relationship between the orientation of the long axis of SNT and variation in eruption status was explored and shown to be statistically significant (p=0.0000). It was found that the highest number of erupted SNT (63.28%) had vertical orientations, followed by SNT with oblique orientations (33.59%). SNT with inverted orientations failed to erupt into the oral cavity. In this sample, only 3.13% of SNT with no discernible long axes, such as those found in the odontoma category, erupted into the oral cavity.

Regardless of their status of eruption, 45.88% of the SNT was associated with local aberrations in the dentition of the affected subjects (p=0.0551). The various problems catalogued were the spacing of teeth, displacement of teeth, impactions, and complications such as the formation of cysts.

Displacement of teeth (p= 0.0002) and impaction of adjacent teeth (p=0.0006) were the most significant problems encountered.

The age distribution of subjects diagnosed with SNT was also recorded. It was seen that the maximum number of SNT were recorded in patients belonging to the third (f=194) decade of life.

Region-wise (anterior, premolar and molar regions) there was a difference in the age ranges of subjects in whom SNT was detected (see Table III). In the anterior regions of the jaws, the maximum number of SNT (Maxillary:36 vs Mandibular:9) was recorded in subjects whose ages belonged to the second decade of life (11-20years)

From the frequency table it can be seen that the highest number of SNT (f=38) seen in the mandibular premolar region was distributed equally in the second and third decades of life, whereas for maxillary premolars the highest frequency(f=17) of SNT was in the third decade of life. In the molar regions, the frequency of SNT was highest in the third decade for the maxillary molars (f=103) although for the mandibular molars the highest frequency of SNT (f=20) was seen in the second decade of life.

Inter- and intra-examiner reliability

To assess the intra-reader strength of agreement, 60 radiographs were randomly selected and re-evaluated using Cohen's kappa statistic value. The kappa statistic value of 0.96 demonstrates an excellent strength of agreement. To determine inter-examiner reliability, 10 radiographs were re-assessed by another researcher and compared. The kappa value of 0.75 revealed that the inter-rater agreement was also excellent.

DISCUSSION

A panoramic radiograph is a two-dimensional (2D) radiograph that can detect pathologies or abnormalities in the dental arches and associated structures and has been used as an essential diagnostic tool for more than half a century. [17].Despite its various limitations such as magnification and superimposition of images, panoramic radiographs are still generally used in almost all dental specialities for overall screening.[18] In orthodontics, panoramic radiographs are taken routinely to detect malocclusions, gather information about the present, missing or additional number of teeth, assess axial inclinations, evaluate mesiodistal root angulations, and as a guide in establishing proper root position [6,19–22]

The rationale of this retrospective panoramic radiographic study was to provide some understanding of the prevalence

Table III: Age ranges and frequency of SNT in various regions of the jaws

Age range	Frequency in Maxillary anterior	Frequency in Mandibular anterior	Frequency in Maxillary premolar region	Frequency in Mandibular premolar region	Frequency in Maxillary molar region	Frequency in Mandibular molar region
>=10years	11	1	4	7	1	12
11-20 years	36	9	7	38	68	20
21-30 years	16	1	17	38	103	9
31-40 years	13	3	5	18	39	1
	76	14	33	101	211	41

https://doi.org/10.17159/sadj.v78i02.16187

and characteristics of SNT in a contemporary, living cross-sectional sample of the South African population. The role of SNT played in the malocclusion of an individual was also explored by noting the various orthodontic problems in affected individuals.

Malocclusions caused by SNT such as delayed eruption, impacted teeth, crowding or a diastema in the anterior region[6] may negatively affect the aesthetics, mastication and speech of children. Furthermore, supernumerary teeth are associated with many complications such as ectopic eruption and/ or root resorption of adjacent teeth, formation of pathologic cysts or root dilacerations.[4,5,12,13] Early detection and orthodontic and/or surgical interventions are of significant value in reducing future clinical problems and establishing proper occlusion of adjacent permanent teeth.[23]

The prevalence of SNT in this sample was 2.48%. This was comparable to the prevalence rate of 0.1-3.8% quoted in studies on Caucasian populations [4,10] and less than the 2.7-3.4% recorded for Asian and Japanese populations.[9,24] The prevalence was also lower than the rate of 6.7% found in the skeletal remains of a mining community in Kimberley, South Africa.[14] Differences in prevalence among populations may be attributed to variations in sampling method and sample sizes, age of subjects, diagnostic tools used and geographic area.

Based on their morphology, SNT were broadly classified into four different types in this study. It was found that most of the SNT were of the supplementary type (72.94%), followed by conical (15.86%), odontoma (10%) and the tuberculate (1.48%) types. This finding was not in congruence with other published reports[3,6,25,26] on SNT in which the most prevalent morphology recorded for SNT was of the conical type.

The distribution of SNT in this study did not demonstrate any sexual dimorphism. This finding is at variance with many studies published in the literature, which indicate that males were more affected than females, with a relative frequency of around 1.5:1 or higher.[1,10,27,28]

A predilection of SNT for the maxillary jaw, as reported by Khandelwal[29] among others[3,30] was also noted in this study. When considering specific sites within the jaws, the tendency of the majority of SNT to occur in the posterior sections of the jaws, mainly the maxillary molar region and the mandibular premolar region in this study, was a finding similar to the results reported by Hajmohammadi *et al,.*[8] in an Iranian sample. In stark contrast, many studies on other populations in various geographical regions reported the premaxillary or anterior region as the most common site for the occurrence of SNT. [4,7,31]

Our results resonate with the findings of other researchers in the literature studied, who state that the majority of supernumerary premolars (75%) are found in the mandible.[31,32] Similarly, a high incidence of SNT in the mandibular premolar region was noted in the Nigerian population.[33,34] The question arises whether predilection of SNT for the mandibular premolar regions of the jaws is a tendency seen predominantly in population groups within a specific geographic area. Only future research within the African continent could provide some clarity on this matter.

Many reports in the literature testify to the presence of late-developing supernumerary premolars in patients.[34,35] In our study the majority of SNT in the mandibular premolar regions were detected in the second and third decades while in the maxillary premolar region, the majority were detected in the third decade. The presence of SNT in the premolar region may compromise orthodontic attempts at tooth movement and space closure. In such instances, it is advisable to extract these extra teeth. The inter-radicular spaces between the maxillary second premolar and first molar, the maxillary first molar and second molar and the mandibular first and second premolars, and the mandibular first molar and second molars are cited as good implant sites for the placement of orthodontic mini-implants when additional orthodontic anchorage is needed.[36,37] The high incidence of SNT in the maxillary molar and mandibular premolar regions of the South African population may jeopardise orthodontic mini-implant placement in these areas. Clinicians should proceed with caution in such instances, as the stability of the implant may be compromised due to insufficient inter-radicular clearance owing to the presence of extra teeth.

The majority of the SNT recorded in this study remained unerupted, an observation supported in other studies as well.[3,8,30] In agreement with the findings of a Taiwanese study,[38] the highest number of erupted SNT belonged to

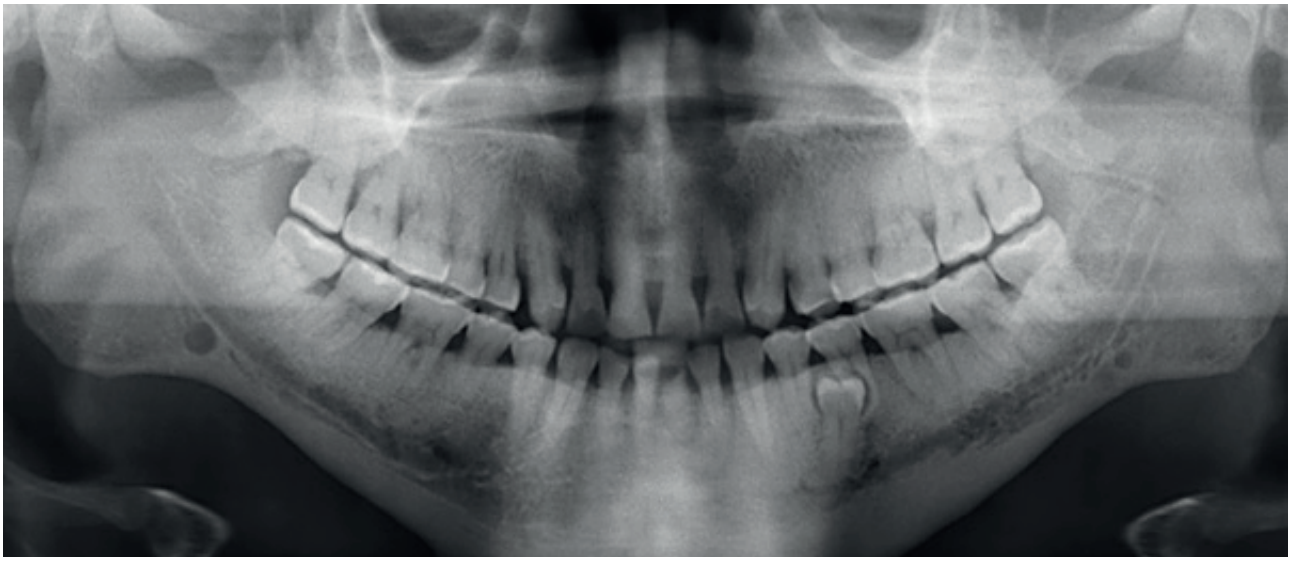

Figure 6: Panoramic radiograph depicting a supernumerary tooth in the premolar region

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the supplemental category. The majority of the erupted SNT (63.28%) had a normal orientation, an observation supported in other studies as well.[28,39]

SNT may be associated with dental malocclusions and complications.[6,40]

Many studies support the use of panoramic radiographs as an initial screening tool to identify dental anomalies and related orthodontic complications[16,20–22,41]. Accordingly, this radiographic study looked at dental malocclusions[6,13,23,40] and orthodontic complications[38,39] related to SNT such as displacement, impaction, spacing of affected teeth and formation of dentigerous cysts that are readily assessed on panoramic radiographs. However, it is important to note that, panoramic radiographs have limitations and should be used in conjunction with other diagnostic tools such as a clinical examination, dental history and study models to fully evaluate and form a comprehensive diagnosis of a patient's orthodontic problems and needs.

Displacement and impaction of adjacent permanent teeth were the most pertinent problems encountered in this study population. When it has been established that SNT is the main cause for the impaction of teeth, removal of the SNT is warranted. This may be performed in isolation or in conjunction with surgical exposure of the impacted tooth. If there is adequate space in the dental arch, spontaneous eruption and alignment of the impacted tooth may occur, while in some cases, orthodontic intervention may be necessary. Early diagnosis of SNT plays an important role in this regard, as teeth with more advanced root development are less likely to erupt spontaneously. Therefore, when such clinical problems are seen in patients, it would be advisable to conduct a radiological examination to determine whether SNT is the cause and to determine the extent of root development.

It is interesting to note that the majority of SNT in the anterior region was recorded in subjects in their second decade (11-20 years) of life. Anecdotal observations by orthodontists indicate that this is the typical age range (11-20 years) when most individuals seek orthodontic treatment for matters affecting their dental appearance and function. The highest number of SNT in the posterior regions was detected in the third decade of life. Perhaps this might have been due to the fact any malocclusion caused by SNT in the posterior region is of less importance to an affected individual when compared to the anterior regions, where aesthetics play an important role. There are also reports of late developing supernumerary teeth that develop much later than the normal dentition; these are usually found in the premolar region.[31,35] These factors might account for the older age range of subjects detected with posterior SNT. Future research on SNT may help to provide greater insight into this observation.

The authors acknowledge that the under-representation of SNT may have occurred in this sample due to various factors. For instance, patients might have undergone a supernumerary tooth extraction or had a normal tooth mistakenly extracted as a supernumerary tooth in the past. Consequently, they may have presented to the hospital with a "normal" complement of teeth, leading to an underestimation of the prevalence of SNT in the sample It is critical to consider these potential sources of bias when interpreting the study's findings.

Nevertheless, the current study provides important insights into the prevalence and distribution of SNT in a contemporary South African patient population and contributes to important information in the field of SNT research.

CONCLUSION

Although the prevalence of SNT was similar to those data generally recorded in the literature for other populations, the distribution of SNT within the jaws showed a distinct departure from other studies, in that the majority of the SNT were in the maxillary molar and mandibular premolar regions.

Only 27% of the SNT had erupted in the oral cavity which again highlights the importance of diagnostic radiographs to detect the presence of SNT. The relationship between morphology and orientation of SNT on eruption status revealed associations of significance. In this study, the majority of the erupted SNT were of the supplemental type. SNT with vertical orientation were more likely to erupt into the oral cavity, while SNT with inverted orientation did not erupt at all.

Common dental problems associated with this developmental defect were displacement of teeth and impaction of adjacent permanent teeth. The role of SNT must therefore be included in the differential diagnosis of such cases. During the treatment phase, the presence of SNT may hinder orthodontic tooth movement and space closure. In addition, due to the increased incidence of SNT in the maxillary molar and mandibular premolar region, caution is advised when planning the placement of implants for anchorage reinforcement in this population group.

Conflict of interest

None.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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CPD questionnaire on page 108

The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

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https://doi.org/10.17159/sadj.v78i02.16188

Neoplastic tissue transfiguration *in vivo* by recombinant human transforming growth factor-β_3

SADJ March 2023, Vol. 78 No.2 p82-85

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ABSTRACT

Keywords

Human transforming growth factor-β_3, human squamous cell carcinoma, tissue transfiguration, de-differentiation, neoplastic transformation.

Human oral squamous cell carcinomas (hSCCs) are the most common head and neck cancers now presenting with more aggressive biological and clinical features due to smoking and alcohol together with widespread viremia. Transforming growth factor-β (TGF-β) proteins are powerful morphogens that induce rapid and substantial induction of endochondral bone formation but in primates only.

Intramuscular heterotopic Implantation of 125 µg hTGF-β_3 generate organoids that show tissue transfiguration *in vivo* with rapid and substantial induction of mineralised bone by days 15 and 30 with large osteoid seams populated by contiguous osteoblasts, with rapid replacement and transfiguration of the *rectus abdominis* muscle into bone. Biopsies from hSCCs were implanted subcutaneously into athymic nu/nu scid mice. Rapidly growing masses were injected with 250 µg hTGF-β_3 reconstituted with 300 µl Matrigel®Matrix kept fluid on ice. Stained sections showed poorly differentiated up to anaplastic hSCCs at the periphery of the transplanted masses with a more differentiated keratinised oncotype in the centre of the growing carcinomas. qRT-PCR showed significantly up-regulation of *Keratin 17* with down-regulation of the *Peptidase Inhibitor 3* gene. The results indicate that the transfiguration patterns seen in the centre of hTGF-β_3 -Matrigel®Matrix injected specimens activates the cellular memory of the transplanted carcinomas with the induction of differentiated oncotypes with keratinised pearls of tumour growth markedly contrasting with the peripheral anaplastic carcinomatous landscape.

Significance

Carcinomas survive by recapitulating mechanisms of normal development. The transfiguration mechanism(s) by hTGF-β_3 in Matrigel®Matrix set into motion gene expression pathways reintroducing a memory of developmental events already known to the altered cells bringing neoplastic cells back to their initial stage with keratinised pearls of a highly differentiated oncotype. The injections of 250 µg of hTGF-β_3 in Matrigel®Matrix re-introduce a memory of developmental pathways already known to the affected cells, bringing back neoplastic cells to its initial non-neoplastic and keratinised initial status.

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Perspective

Malignant tumours are the leading cause of death across both developed and underdeveloped countries (https://www.cancer.gov/about-cancer/understanding/statistics). Combined chemo-, radio- and surgical treatments are not yet – if ever will be – biologically and surgically successful to therapeutically resolve human malignancies.[1]

Because of the combination of alcohol, smoking widespread viremia, and as yet unknown immunological and bacteriological causes, human oral squamous cell carcinomas (hSCCs) are now presenting with much more aggressive biological and rampant clinical features.[2] Extant features present a morphological and clinical pattern of aggressive rapid growth with anaplastic invasion. [3-5]

Experimentation in the Chacma baboon *Papio ursinus* has shown that the recombinant human transforming growth factor-β_3 (hTGF-β_3) is the most powerful osteoinductive morphogen so far tested in primates.[6,7] Our systematic studies in heterotopic *rectus abdominis* sites reported the rapid and substantial induction of bone formation with newly formed ossicles comparable to organoids. Generated organoids show tissue transfiguration *in vivo* with rapid and substantial induction of mineralised bone by days 15 and 30 with large osteoid seams populated by contiguous osteoblasts.[6,7]

EMBEDDING MOLECULAR SIGNALS INTO NEOPLASTIC MASSES: TISSUE TRANSFIGURATION *IN VIVO*

Because of the pleiotropic multifaceted biological activity of hTGF-β_3 in primates' tissues and microenvironments, experiments were set to transfigure anaplastic human oral squamous cell carcinomas (hSCCs) by direct intra-tumoral

https://doi.org/10.17159/sadj.v78i02.16188

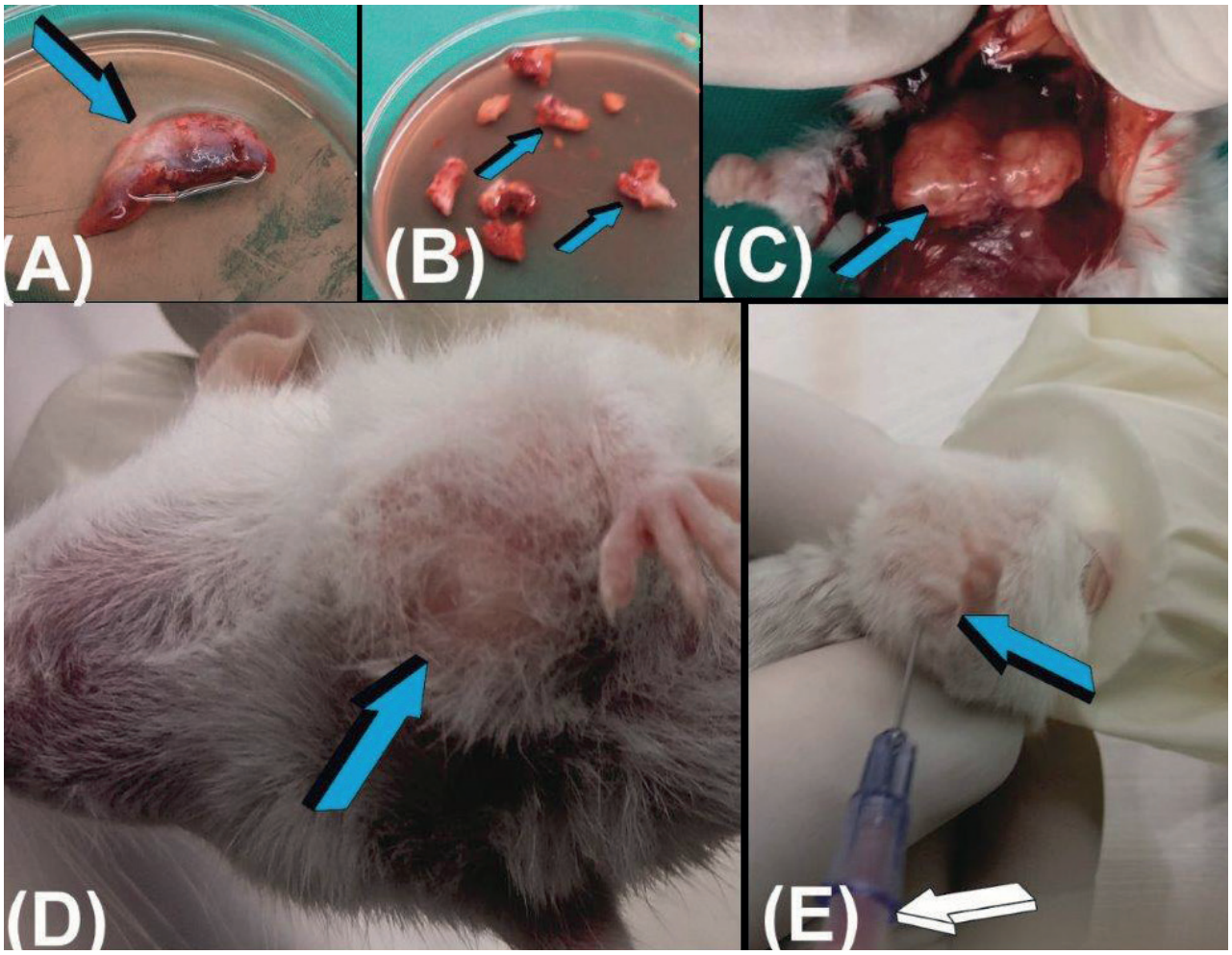

Figure 1: Transplantation of human squamous cells carcinomas (hSCCs) debrided from human patients at oncologic surgery. (A) Large fragment of a hSCC (blue arrow) brought in sterile medium to the WRAF. (B) Fragmented carcinomas (blue arrows) are transplanted subcutaneously in athymic scid nu/nu mice. (C) Bilateral growth of hSCCs over the chest of a scid nu/nu mouse 30 days after heterotopic transplantation. (D) Growing hSCC (blue arrow) after transplantation of a human SCC biopsy 30 days after transplantation just before the intra-tumoral injection of 250 µl of Matrigel®Matrix (white arrow) recombined with 250 µg recombinant human transforming growth factor-β_3 (hTGF-β_3).

injections of relatively high doses of hTGF-β_3. Human and animal ethics clearances were obtained from the University of the Witwatersrand, Johannesburg (Human Research Ethics Committee Clearance no. M150608; Animal Research Ethics Committee AREC no. 2014/39/C). Athymic *scid* mice were purchased from The Jackson Laboratories, US and kept in a sterile microenvironment at the Wits Research Animal Facility (WRAF).

Biopsies from harvested hSCCs at the time of surgical debridement (Figure 1) were implanted subcutaneously into *scid* mice over the lateral chest into the *pectoralis'* muscle opened by blunt dissection (Figure 1C). Histological analysis of transplanted hSSCs showed the classic hallmarks of highly differentiated anaplastic cells with hyperchromatic nuclei (Figures 2A,B).

Transplanted hSCCs required just over three weeks to "graft" into the host nude mice followed by growth for a further six to seven days to sizeable masses of 5/7 mm diameter (Fig. 1C). Half of the growing hSCCs in the subcutaneous space of the athymic scid mice were injected with 250 µg hTGF-β_3 reconstituted with 300 µl Matrigel®Matrix kept fluid on ice (Figures 1E). Transplanted masses were injected up to four times in selected animals. The remaining hSCCs were not injected, to monitor the carcinomatous growth of hSCCs without hTGF-β_3 injections *in vivo* (Figure 1C).

Due to a high mortality rate of the implanted mice, tissues for molecular and histological analyses were limited to two non-injected hSCCs harvested at 3 and 5 weeks after heterotopic implantation, and seven hSCCs injected and harvested at weekly intervals. Samples for molecular analysis were flash frozen in liquid nitrogen and stored at -80°C. Examination of resin-embedded sections cut at 3 to 4 µm (Morphisto AG, Germany) showed the development and growth hSCCs across the cut sections (Figures 2A,B).

The heterotopic subcutaneous growth of hSCCs is a fundamental result that shows the transplantation of viable hSCCs from bioptic surgical material (Figures 1A,B; 2A,B). Histological examination of the resin-embedded sections showed a reproducible recurrent histological pattern of undifferentiated anaplastic growth at the periphery of the transplanted hSCCs biopsies with a different yet reproducible pattern of a differentiated oncotype in the centre (Figures C,E; Figs. D,F). The morphological data showed reproducible patterns of growth spatio/temporally distributed, i.e. poorly differentiated up to anaplastic hSCCs at the periphery of the transplanted tumours (Figures D,F) with a more differentiated keratinised oncotype in the centre of the injected growing carcinomas (Figures 2C,E).

The oncotype pattern' variations are of great significance. The morphological data show reproducible patterns of growth

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https://doi.org/10.17159/sadj.v78i02.16188

spatio/temporally distributed, i.e. poorly differentiated anaplastic hSCCs at the periphery of the transplanted biopsies *vs.* more differentiated with keratinised oncotype in the centre of the injected growing carcinomas, thus less malignant with a more differentiated oncotype in the centre following injections of doses of hTGF-β_3 in Matrigel®Matrix. Injected hSCCs thus induced an oncotype characterised by a shift into highly differentiated oncotypes with multiple pearls of keratinisation (Figures 2C,E). Molecular analyses were later performed on the flash frozen harvested tissues sampled according to origin. The shift into a different oncotype characterised by multiple pearls of keratinisation is mechanistically highlighted by overexpression of the human *Keratin 17* gene in hTGF-β_3 injected samples when compared to untreated hSCCs control (Figure 3).

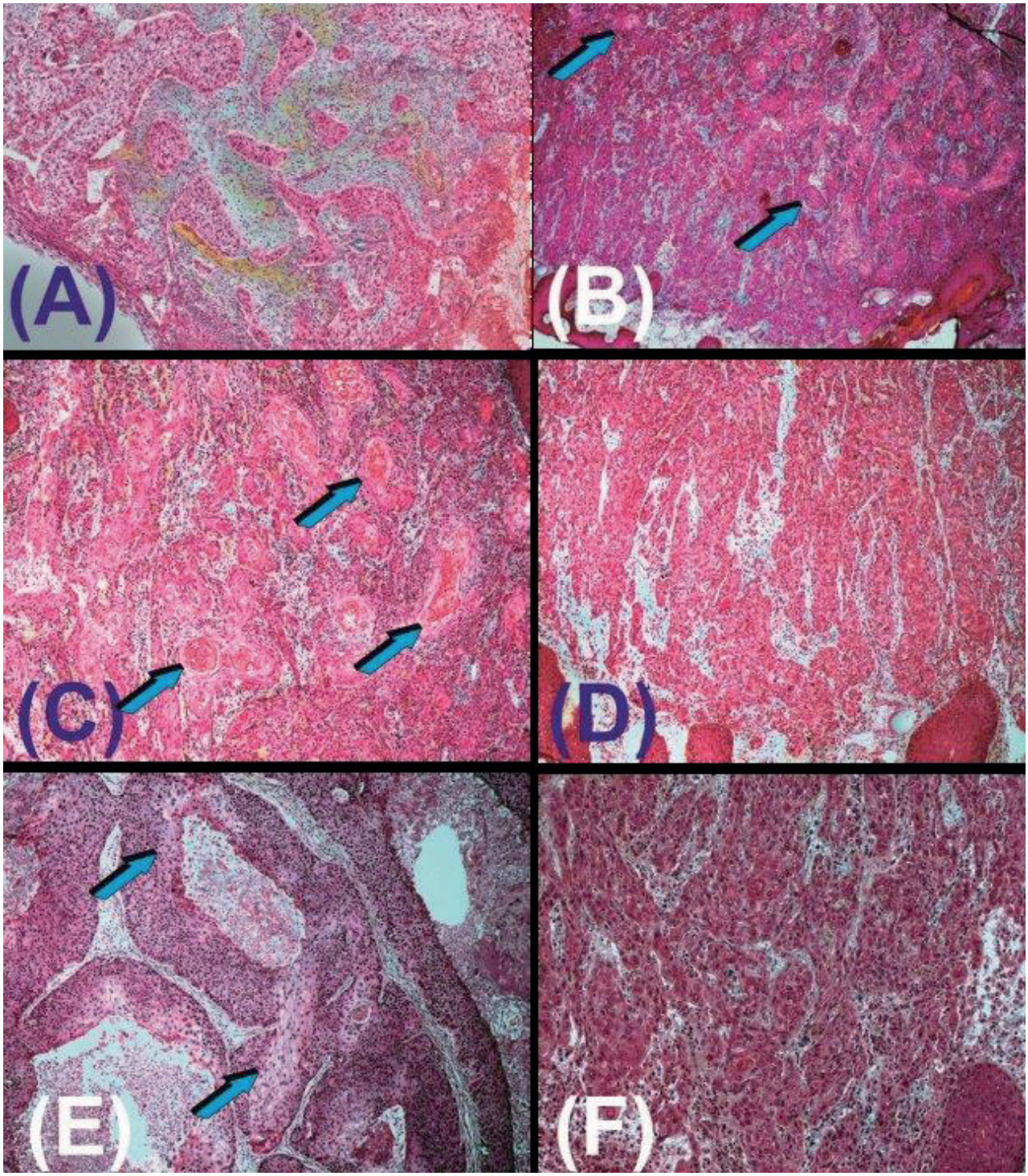

Figure 2: Composite iconographic plate showing tissue transfiguration of anaplastic human squamous cell carcinomas (hSCCs) into more differentiated oncotype after hTGF-β_3 injection in the centre of the transplanted hSCC growth. (A,B) Transplanted human squamous cell carcinomas (hSCCs). The neoplastic growths have not been injected. Image in (B) shows occasional keratin pearl formation (blue arrows). (C) Transplanted hSCC representing a section of the centre of the lesion that has been injected. The lesion is histologically well differentiated and shows increased keratin pearl formation (blue arrows) when compared to non-injected tumours. (D) Transplanted hSCC representing a section of the periphery of the neoplastic growth. The periphery of the lesion appears less differentiated than the centre of the same lesion (C). (E) Transplanted hSCC with hTGF-β_3 in Matrogel®Matrix injected into the centre of the lesion showing abundant keratin differentiation (blue arrows). (F) Periphery of a hSCC injected with hTGF-β_3 in Matrogel®Matrix showing poorly differentiated hSCC with several anaplastic cells.

https://doi.org/10.17159/sadj.v78i02.16188

RNA was extracted using the RNeasy Micro Kit (Qiagen, GmbH, Hilden, Germany). RNA quantification, cDNA synthesis and quantitative real time polymerase chain reaction (qPCR) were as performed as previously described.[8] Expression levels of *Keratin 17* and *Peptidase Inhibitor 3* normalised using three reference genes, were compared between hTGF-β_3 treated and untreated samples harvested from the scid mice and sections of the original hSCC biopsies used for the implantation. *Peptidase Inhibitor 3* was significantly down-regulated and *Keratin 17* expression significantly elevated in hTGF-β_3 treated samples compared to the untreated controls ($p < 0.01$ and $p < 0.05$, respectively) (Figure 3). The above tested genes were genes of interest identified in a genome wide expression profiling of oral squamous cell carcinoma.[9]

Non-injected hSCCs specimens showed a reproducible pattern of anaplastic growth throughout the transplanted hSCCs in the subcutaneous tissues of the operated athymic mice (Figure 2). hTGF-β_3 injected specimens showed a reproducible pattern of neoplastic growth with anaplastic differentiation at the periphery of the transplanted and injected SCCs. In the centre of the injected lesions, there was the differentiation of a highly differentiated oncotype with keratinised pearls of tumour growth markedly contrasting with the peripheral anaplastic carcinomatous landscape (Figures 2C,E). Cancers survive by recapitulating mechanisms of normal development.[10] The transfiguration mechanism(s) by hTGF-β_3 in Matrigel®Matrix set into motion gene expression pathways reintroducing a memory of developmental events already known to the altered cells bringing neoplastic cells back to their initial stage with keratinised pearls of a highly differentiated oncotype.

Endogenous TGF-β suppresses tumorigenesis in a breast cancer xenograft model by affecting cancer stem cells or early progenitors.[11] The paper reported that endogenous TGF-β has the potential to function as a tumour suppressor in carcinomas by *"depleting the putative cancer stem cells or early progenitors cell population and by promoting differentiation of the more committed progeny"*.[11] The findings that endogenous TGF-β is promoting differentiation of the more committed progeny, is also shown morphologically and molecularly in our study embedding hTGF-β_3 in fluid Matrigel®Matrix on ice resulting in the induction of differentiated oncotypes.

The injections of the 250 µg of hTGF-β_3 in Matrigel®Matrix re-introduce a memory of developmental pathways already known to the affected cells, bringing back neoplastic cells to its initial non-neoplastic and keratinised initial *status*.

ETHICS APPROVAL

Human and animal ethics clearances were obtained from the University of the Witwatersrand, Johannesburg (Human Research Ethics Clearance no. M150608; AREC 2014/39/C).

CONSENT FOR PUBLICATION

The authors agree with the contents of the manuscript and provide consent for publication. Availability of data and materials: Data are available upon request.

FUNDING

The University of the Witwatersrand, Johannesburg, for the Wits Seed Fund WSF15/04, and the SA NRF for a 2015 award of The Blue Skies Funding Instrument, Grant no. 93117.

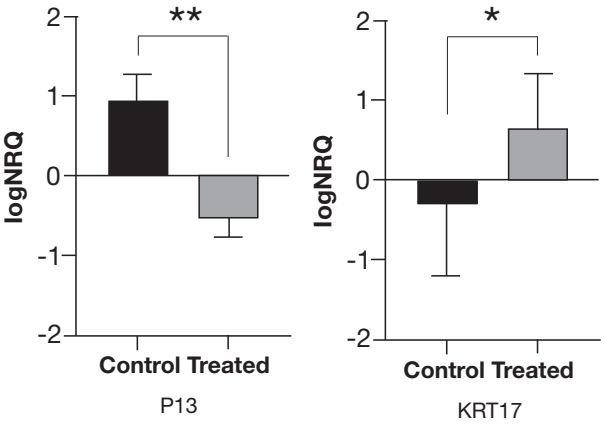

Figure 3: Comparison of *Peptidase Inhibitor 3* (*PI3*) and *Keratin 17* (*KRT17*) gene expression levels from samples harvested from hTGF-β_3-treated and untreated scid nu/nu mice and hSCC biopsy samples. The expression of *Peptidase Inhibitor 3* was significantly down regulated and Keratin 17 expression significantly elevated in hTGF-β_3 treated samples compared to the untreated controls ($p < 0.01$ and $p < 0.05$, respectively).

COMPETING INTERESTS

The authors confirm that there are no conflicts of interest.

AUTHORS' CONTRIBUTIONS

Ugo Ripamonti conceptualised, designed the study and surgically implanted the human biopsy material in scid nu/nu mice; Peter Swart analysed the histological sections; Caroline Dickens and Raquel Duarte prepared the material for molecular analyses, designed primers and performed and analysed qRT-PCR. Ugo Ripamonti wrote the manuscript and all authors commented, edited, and approved the final manuscript.

ACKNOWLEDGMENTS

The University of the Witwatersrand, Johannesburg, for the continuous support of our studies on the hTGF-β_3 isoform, kindly supplied by Novartis AG, Zurich. Dr Lisa Burnell for the supply of surgical bioptic material of hSCCs.

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https://doi.org/10.17159/sadj.v78i02.16144

Proteus Syndrome – A one in a million occurrence

SADJ March 2023, Vol. 78 No.2 p86-91

LM Sykes[1], C Bradfield [2]

KEYWORDS
Proteus syndrome; craniofacial deformity; AKT1 gene mutation

ABSTRACT
The syndrome is named after the Greek sea-god Proteus, who could change his shape.

Proteus Syndrome (PS) is a rare condition with an incidence of less than 1 in 1 million people. It is characterized by variable, multifocal overgrowth of bones, skin, or other tissue derived from any of the three germinal layers. It is generally not apparent at birth, but signs develop rapidly from as early as 6 months and get more severe with age. Craniofacial deformities are less frequent but overgrowth of facial bones leads to disfigurement, malocclusion and a number of other oral and dental anomalies. The following case report of a young boy with PS was written for three reasons. Firstly, it will describe this unusual condition to colleagues who have never encountered patients with the syndrome. It then stresses the importance of a holistic approach to treatment planning. This entails addressing the immediate needs, and then basing the definitive treatment on considerations of possible short- and long-term, patient-related developments. Finally, it illustrates how a complex case was treated successfully with conservative management using modifications of standard clinical procedures.

INTRODUCTION
Proteus Syndrome (PS) is a sporadic condition caused by the AKT1 gene mutation, and characterized by highly variable, multifocal, disproportionate and asymmetric overgrowth of the bones, skin, or any other tissues, derived from any of the three germinal layers.[1, 2, 3] The affected organs and tissues grow faster than the surrounding areas leading to both sizeable physical distortion as well as impaired and / or limited movement. It is compounded by the fact that growth is generally asymmetrical and affects the right and left sides of the body differently. It may affect almost any part of the body, but the most common sites are the bones in the limbs, skull, and spine, followed by the skin[1]. The pattern of enlargement varies greatly, especially in the skin where it presents with a characteristic feature known as cerebriform connective tissue nevi, which are thick, raised, and deeply grooved lesions. These usually occurs on the soles of the feet and are rarely ever seen in any other condition, as well as epidermal nevi, vascular malformations, and dysregulated adipose tissue.[1,3] Other common manifestations include macrodactyly (partial gigantism of hands or feet), vertebral abnormalities, asymmetric muscle and limb growth with length discrepancies, hyperostosis, and restricted movement.[1,2,3] Some people with PS have neurological abnormalities, including intellectual disability, seizures, brain malformations and vision loss.[1,3,4] Many also display distinctive facial features such as dolichocephaly / long faces, down-slanting palpebral fissures on the outer corners of the eyes, ptosis, low nasal bridges with wide or anteverted nares, and an open-mouth expression.[1] It appears that these characteristics are more commonly seen in those who also have neurological symptoms, but the reason for this is not known. It is also unclear how or why these features are related to the abnormal growth.[1]

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Craniofacial deformities are less frequent than the skeletal abnormalities, and are associated with exostoses and overgrowth of membranous bones (30% of patients), leading to dentofacial disfigurement and often malocclusion.[4] The dentition is reported to be involved in approximately 18.6% of patients, with the most common features being tooth agenesis, ectopia, gingival hypertrophy, crowding, malocclusion, multiple frenula, high arched palate, asymmetrical hypertrophied tongue and enamel hyperplasia.[4]

INCIDENCE AND PRESENTATION AT BIRTH

Proteus Syndrome is a rare condition of unknown aetiology, with an incidence of less than 1 in 1 million people, thus very few cases have been reported in the literature.[3] It is generally not apparent at birth, with less than 17.5% of neonates showing any early signs of asymmetry, however these develop rapidly in early childhood.[3] Overgrowth becomes apparent between the ages of 6 and 18 months and gets more severe with age, although in some cases it has been seen to stabilize in adolescence.[1,2,3] It has a male to female sex ratio of 1.9:1.3 Of interest is that the change is not inherited but occurs randomly in one cell during the early stages of foetal development, as such, it does not run in families.[1] The condition is postulated to arise as a result of a mutation in the AKT1 gene, where some cells will have the mutation and other cells will not. This finding of a mixture of cells in the absences of a genetic mutation, is known as mosaicism.[1] The AKT1

https://doi.org/10.17159/sadj.v78i02.16144

Figure 1. Old acrylic resin denture showing numerous repairs and poor denture hygiene.

Figure 2. Maxillary arch showing absent teeth and bony tori.

gene helps regulate cell growth, division, proliferation, and death, thus if an abnormality in this gene disrupts the cell's ability to regulate its own growth, it could then grow and divide abnormally leading to the characteristic features seen in patients with PS.[1]

SIMILAR CONDITIONS AND DIAGNOSIS

Proteus syndrome may be over diagnosed, or misdiagnosed, as individuals with other conditions featuring unilateral overgrowth such as ossifying fibroma, osseous dysplasia, fibrous dysplasia, neurofibromatosis type 1, Kippel-Trénaunay syndrome, hemihyperplasia-multiple lipomatosis, familial lipomatosis, symmetric lipomatosis, epidermal nevus, Maffucci syndrome, and Bannayan-Riley-Ruvalcaba syndromes have often been mistakenly diagnosed as Proteus syndrome.[1,2,4,5] There are strict guidelines to follow in order to make a definitive diagnosis of PS, and all of these need to be present to confirm the classification. These include: mosaic distribution of lesions; sporadic occurrence; progressive course; and rapid asymmetric and disproportionate overgrowth. It also needs to have additional specific criteria from the categories (A, B and C), of which there must be at least 1 feature from category A, or two from B or three from C.[3]

The recommended diagnostic tests for patients with suspected PS include clinical photographs, initial skeletal surveys and follow up comparisons. Tests should consist of radiographs of affected areas, magnetic resonance imaging (MRI) of the chest, abdomen and pelvis (to exclude aggressive intra-abdominal lymphomas), dermatological evaluation and biopsies if indicated. Additional MRIs of the central nervous system may help identify neurological abnormalities that can be associated with mental deficiencies and / or seizures.[1,2,3] Chest X-rays, Computed tomography (CT) imaging, pulmonary function tests, and selected genetic tests aid in identification of other genetic disorders. Treatment may involve orthopaedic consultation and operations where needed, continuous paediatric management and referral to family counselling and support groups.[2,3,5] The different skeletal problems may be addressed by various surgical procedures such as "epiphyseodesus for asymmetrical epiphyseal growth, reduction osteotomies to shorten or straighten long bones, shoe lifts for mild leg length discrepancies, prosthetic joint replacement, and spinal fusion to prevent development of kyphoscoliosis".[3] A further complicating factor associated with the rapid overgrowth of long bones is that they have abnormally thin cortices, and deficiencies of the overlying soft tissue which do not grow at the same rate, and adds to the restricted mobility.[3]

A recent systematic review of maxillofacial manifestations of PS (2021) found 14 papers that reported on patients with PS.[4] Most of them were case reports of single patients, and focused specifically on the imaging modalities used to help in the diagnosis.[4] Conventional panoramic radiographs were generally used as they provide a large amount of information such as the presence of impactions, tooth agenesis, root dilacerations, resorption, ectopic eruption, asymmetric dental maturation and asymmetric enlargement of the alveolar bones.[4] Lateral cephalometric radiographs and CT scans were used for treatment planning or when any form of intervention was envisaged. Intraoral findings in the 14 cases included the following: malocclusion (2 patients); dental crowding (2); crossbite (2); dental ectopia, rotations, enamel hypoplasia, tooth agenesis, impactions (2); high arched palate, unilaterally enlarged alveolar bone (2); gingival hyperplasia (3); unilateral enlargement of the tongue (3); maxillary or mandibular prominence (4); jaw atresia (1); anterior open bite, teeth in infraocclusion (2); tilted occlusal plane, enlarged zygoma (1), delayed eruption, deviated midline, osteomas, unilateral enamel hypoplasia (1). Most of the papers reported that the teeth present were normal in size and shape.[4]

POTENTIAL COMPLICATIONS

Patients with PS have an increased risk of developing various types of benign tumours and blood clots, most notably thromboembolism. If these become dislodged from the limb vessels they may travel to the lungs causing respiratory complications and pulmonary emboli. The latter are a common cause of premature death in these patients due to the compounded burden of vascular malformations, frequent surgical procedures, and restricted mobility.[1,2] Antithrombotic prophylaxis is recommended for any surgical interventions to try prevent this.[3]

CASE REPORT

A 29-year old male patient who had been diagnosed with PS by molecular genetic testing at the age of 3 years, presented to the dentist requesting a new denture. The old one was not fitting him anymore.

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Figure 3. Mandibular arch showing diastema and bony tori.

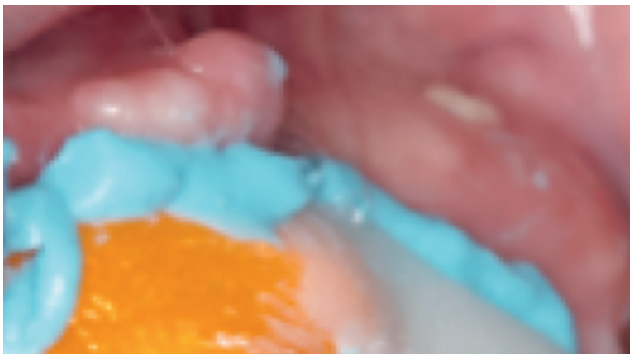

Figure 4. Bony tori preventing the impression tray from seating.

The old denture was reportedly more than 10 years old, badly stained, covered with plaque, and had signs of previous repairs (Figure 1). It was difficult to assess the denture fit due to his restricted mouth opening, however once it was inserted it was clear that this prosthesis would never fit due to the numerous bony overgrowths, undercut areas and exostoses that had developed. Further intraoral examination revealed that he had very few remaining teeth (14 and 15 in the maxilla, and 31-34 and 42-44 in the mandible) with a 19 mm diastema between the 42 and 31 (Figures 2 and 3). The other teeth had been extracted over the years, but neither he, nor his mother could elaborate on how many teeth had been lost to establish if he had developed a full complement of teeth initially.

His mother could also not give any accurate details regarding time of eruption or eruption patterns. The remaining teeth all appeared normal in size and structure, but it was not possible to assess their roots, bony support or internal morphology as the restricted mouth opening and bony interferences hindered the insertion of a radiograph sensor and the possibility of capturing any meaningful images. An additional obstacle was his larger than normal tongue with this characteristic enlargement of the fungiform papillae.

Attempts at taking a panoramic radiograph or CBCT also met with no success as he had a large hump on his posterior neck / upper back that obstructed the moving arm of the machines (*see related comments). An appointment was made for him to have a Lodox X-Ray, however on the day he had a severe migraine** and this had to be cancelled. It was never rescheduled as the clinicians did not feel it justified to subject him to the stress and radiation exposure merely for the sake of their interest and records. Furthermore, the final treatment selected could be carried out adequately without having these images performed.

Extra-oral examination showed the classical facial features of dolichocephaly, downward slanting palpebral fissures on the outer corners of his eyes, ptosis, low nasal bridge with wide or anteverted nares, and an open-mouth expression.[1] He also had numerous soft tissue "blebs" around the eyelids. The patient also had deformities of his hands, arms, legs, feet, back and spine. The former two accounted for his difficulty with oral hygiene measures, while the latter made walking, and sitting in the dental chair / x-ray units a struggle*. A further complication was that he experienced frequent severe headaches and migraines (**see related comments), resulting in many of his scheduled appointments being cut short or cancelled.

TREATMENT OPTIONS AND RESPECTIVE LIMITATIONS

Due to the rarity of the condition, there was very little dental literature to consult when debating the various treatment options. The thought processes and arguments below were based on personal clinical experiences through treating other patients with similar bone or soft tissue abnormalities and atypical growth patterns.

The first consideration in any patient's treatment plan should be to determine if any clinical intervention is needed and possible to perform. Except for emergency care, no treatment is always an option. However, in this case the missing teeth were in the anterior region of the maxilla and needed to be replaced for speech, aesthetics, mastication and to prevent the opposing mandibular teeth from over-erupting. The most conservative choice was to fabricate a removable acrylic resin partial denture. These are quick and relatively inexpensive to make, require minimal tooth preparation, and are easy to insert and remove for oral hygiene purposes.

A chrome cobalt partial denture would ordinarily have been preferred in young patients if they have enough healthy abutment teeth. They are stronger, less damaging to the dentition and gingival tissues, easier to keep clean and reportedly more comfortable to wear. However, in this situation, the patient only had two remaining maxillary teeth, and the added hindrance of constant and unpredictable bone growth in the jaws. An acrylic resin denture was more suitable as it would be easier to adapt and modify to accommodate the ever-changing denture bearing foundation. It was essential to stress to the patient and his mother the need for regular review visits so that the dentist could monitor his condition and adjust the dentures when necessary to avoid them impinging or causing pressure and ulcerations on areas of growth. Denture modifications are relatively simple to perform in acrylic resin dentures, but almost impossible with chrome cobalt.

A further option considered was to manufacture an acrylic resin denture and line its fitting surface with a resilient material such as Molloplast® (Buffalo Dental manufacturing Inc.) or GC Reline ® (GC Australasia) which may be more accommodating of the ever-changing denture bearing area. However additional resilient layers make the denture bulkier, and the resin layer thinner and weaker. They are seldom used in partial dentures. The extra thickness would also have encroached on the interalveolar space, which was already limited due to the excess bone growth in both

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Figure 5. Secondary "pick up impression".

Figure 6. New maxillary acrylic resin partial denture.

his jaws. Furthermore, it would have been more difficult to insert and remove due to his restricted mouth opening, they are less easy to clean and adjust, and are more prone to microorganism contamination.

Fixed bridgework was contraindicated due to the long span that crossed the midline, lack of abutment teeth in the second quadrant, and poor condition of the remaining two maxillary teeth. Even if there had been enough teeth to support a bridge, any bone growth could potentially affect their position, which in turn would create stresses within the bridge framework. This may result in bone loss, tooth loosening, debonding, bridge fracture, and perhaps altered occlusion. On the other hand, if the growth was slow, there was a possibility that the functional units would adapt and there would be no adverse consequences. However, there was no way of predicting the future and the question would be if it was a justifiable risk to take.

Implants were considered as there appeared to be enough bone and the patient was relatively healthy. However, there were far too many factors that ruled against this option. Firstly, the clinicians would have to find a way of taking radiographs to assess bone quality, quantity and to plan for implant placement*. Furthermore, the same concerns about splinting teeth together in bridgework would apply to implants regarding the possibility of bone growth altering their position or angulation. An alternative may have been to keep the implants separate and use them to retain a partial overdenture.

This option was ruled out due to the additional space requirements of the latter. Literature recommends a minimum of 15 mm per arch inter-alveolar space to accommodate an implant-supported prosthesis.6,7 This patient had only 10mm in the second quadrant and would thus need to undergo surgical bone reduction either prior to or at the time of the implant placement. They could also later become submerged if bone grew around the cervical areas, and would need periodic peri-implant alveoplasty to keep their margins exposed. This would risk damaging the threads or the surface of the implant bodies in their most critical area. Implants also need to be positioned at the same height, parallel to the alveolar ridge and equidistant from the midline in order to limit the lateral forces exerted during mastication and to maintain prosthesis stability. If this is not accomplished there will be torsional forces and stresses on the abutments and / or the superstructure leading to prosthesis fracture and possible implant loss.[6,7] With his limited dexterity, and mouth opening, both placement and restoration of the implants as well as subsequent maintenance and oral hygiene were a major concern.

A final consideration is that patients with PS often suffer from vascular complications. Surgery and new bone formation may impinge on vital blood vessels. This in turn may lead to reduced bone turnover and compromise osseointegration. It may add to the already increased risk of venous thrombi, with dire consequences.

DEFINITIVE DENTAL TREATMENT

The patient was accustomed to wearing an acrylic resin removable partial maxillary denture, and based on the above consideration, it was decided that a new one would be the best option for his current needs. The primary impression turned out to be very difficult to take due to his limited mouth opening and atypical ridge shape. (All dental visits were difficult as the patient could not sit comfortably in the dental chair*, had frequent migraines** / panic attacks during the session necessitating them being aborted, and struggled opening his mouth and keeping it open.) After numerous attempts with various modified trays (Figure 4) the dentist decided to make use of his current denture as a special tray. This was trimmed down on the fitting surface to create a space over the areas where his ridges had grown as well as for the impression material. The borders were built up with green stick modelling compound (Kerr Impression compound®, Henry Shein Inc.) and an impression was taken using an irreversible hydrocolloid (Blueprint impression material®, Dentsply Inc).

To limit the number of visits needed, bite blocks were fabricated on the primary cast and at the following visit a mandibular impression was taken along with a jaw relation recording and tooth selection. At the next session the waxed denture was tried in and adjusted at the chairside until all parties were satisfied with the fit, tooth position, speech and aesthetics. The dentist then used this trial denture as a special tray and took a "pick up impression" in it with a light bodied silicone (Coltene President® Silicon impression material Light body, Whaledent Affinis) to capture an accurate secondary impression and pour the final cast (Figure 5). If this procedure is carried out, the clinician must identify and mark the post dam area on the palate, ensure it is transferred onto the intaglio surface of the impression, and scribe it onto the master cast.

Clasp were added to engage the 14,15 and the denture was processed and delivered (Figure 6). The patient was ecstatic with his "new look" as well as all the attention he had received from the treating team (Figure 7).

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Figure 7: Patient wearing his new denture.

He was taught how to insert and remove his dentures, and given instructions on cleaning. A large soft scrubbing brush was adapted by adding a "Velcro" strap to it. This made it easier for him to hold and he was advised to use it in place of the smaller toothbrush to clean his denture.

His mother was counselled on the need to help him maintain intra-oral hygiene and to bring him back for regular maintenance prophylaxis and denture adjustments.

DISCUSSION AND CONCLUSIONS

After 2 months, the patient returned for a recall visit. He was managing well inserting, removing and functioning with his new prosthesis and was overjoyed with the positive feedback he had received from family and friends. The clinicians were still eager to view radiographs of his remaining teeth, and the patient, who was now used to having a prosthesis in his mouth, agreed to another attempt at this. The effort and outcome proved to be more valuable than anticipated. The radiographs confirmed that the 15 and 25 were fully formed and of normal structure (Figure 8).

The second view revealed an impacted / submerged 16 which was not evident clinically (Figure 9). The intriguing feature was that the tooth appeared to have not erupted, and was surrounded by bone and soft tissue, yet it had an inexplicable occlusal radiopacity which resembled a restoration. A possible explanation was that this tooth may have erupted normally and been restored at some time in the patient's past. The tissues could then have grown over the tooth resulting in it now being embedded, and thus seemingly impacted. The superior position may have resulted if the 14 and 15 were carried downwards with the growing bone. Another explanation was that it may have been an artefact due to superimposition of the cusps. A CBCT was performed with a metal marker (the ball clasp on his new denture) in the patient's mouth for reference. It showed the radiopacity clearly in a number of views, and in many it was more opaque than the metal (Figure 10).

This case presented a young man suffering from PS who had many dental and skeletal limitations. It highlights the need for clinicians to have a holistic and compassionate approach towards management of all persons under their care. They need to spend time assessing each new patient carefully and thoroughly at the initial consultation. Thereafter the treatment options and definitive plan must be based on an appraisal of the individual's needs, desires, physical

Figure 8. Well-formed and normally structured 14 and 15

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Figure 9. Submerged / unerupted 16 with an occlusal radiopacity.

/ oral condition, time, finances, and physical limitations, and maintenance requirements, as well as their own skills, facilities, capabilities and ethical values. In this way they will not only be practicing in a caring and compassionate manner, but will also benefit from the peace of mind that comes with knowing they have done their best.

ETHICAL STATEMENT

The patient was asked if his case and illustrations could be used for publication purposes. He was assured of confidentiality and anonymity, and that all illustrations would conceal his identity. Both he and his mother gave full consent to this.

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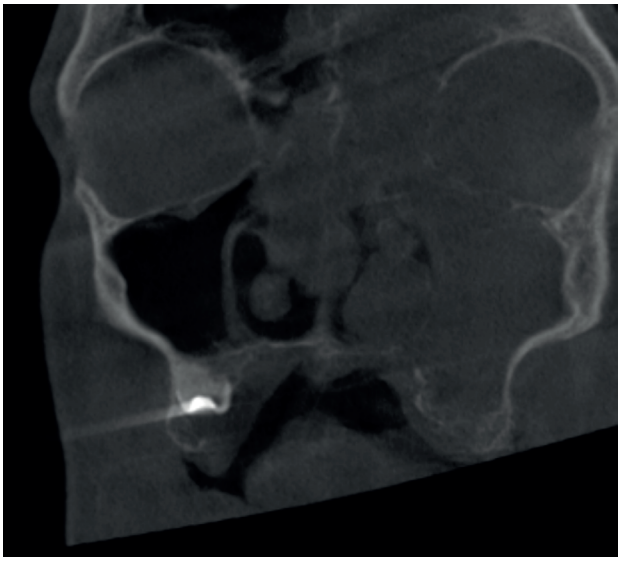

Figure 10. CBCT showing the radiopacity occlusally in the 16

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https://doi.org/10.17159/sadj.v78i02.16165

An innovative digital workflow for the fabrication of a prosthetic ear: A case report

SADJ March 2023, Vol. 78 No.2 p92-96

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ABSTRACT

The aim of maxillofacial rehabilitation is to provide suitable prostheses for patients with oro-facial defects, and enable them to resume their roles in society. Recent advances in bionics and prosthetics have combined different techniques to help in the production of aesthetic and functional prostheses. Technology can now supplement the freehand sculpting skills of the clinician by capturing accurate images of the soft tissues from both the defect and non-defect areas, and using these to digitally recreate the desired templates.

This case report describes the digital steps used to capture necessary data for the design and fabrication of an auricular template, and final ear prosthesis. Results from this case study suggested that the digital method is: 1) more accurate; 2) less time-consuming than traditional methods; and 3) less invasive, and thus more accepted by patients.

Keywords

Maxillofacial prosthetics, Auricular prosthesis, Digital impression, Computer-aided design/computer-aided manufacturing (CAD/CAM), Rapid prototyping, Standard Tessellation Language (STL)

INTRODUCTION

Facial deformity can be emotionally traumatising and could affect the social behaviour of an individual.[1] Maxillofacial prosthetics is defined as the art and science of restoring a malformed or missing part of the human body through artificial means.[2] A prosthesis may be the appropriate treatment when surgical reconstruction is unsuitable or not possible.[3] Maxillofacial prosthodontics aims to provide functional and/or aesthetically pleasing prostheses for patients with facial defects so that they may feel comfortable working and interacting with others in their daily lives.[1] Lifelike facial and body prostheses rely on accurate reproduction of the shape and colour of the missing part, and need to blend well with the surrounding structures in order to make them as inconspicuous as possible.[4] An auricular prosthesis is a removable appliance that offers an alternative to surgical rehabilitation of a missing ear.[5] These have generally been fabricated by means of modelling a template of the missing ear by hand using direct measurements from the dimensions of the opposing ear as a guide. In some cases, impressions of ears from healthy "donor volunteers" have also been used to aid the clinician. The template (usually wax) is then positioned and adjusted at the chairside to ensure it is in the correct alignment with the remaining ear, and of the desired size, shape and extent of protrusion.[6] This process requires a certain amount of artistic skill, to sculpt and carve human anatomy, and can take time to develop and perfect.[4] The final template is then processed into a shade matched silicone prosthesis which may be attached with adhesives, via mechanical means (such as spectacle frames) or with bone-anchored implants.[7]

The conventional way of fabricating an auricular prosthesis is tedious, time-consuming, and relies on the artistic dexterity or the clinician or technician. Two key processes of production are used to record accurate impressions and produce an inverted copy of the patient's normal ear that will fit over the defect.[8] As the process of impression taking of the defective surface is technique sensitive, it may be uncomfortable for the patient.[9] Potential errors include the distortion of the facial soft tissues during the impression taking process.[10]

Recent advances in bionics and prosthodontics have combined different techniques to help with the fabrication of aesthetically pleasing and / or functional prostheses, of which ear prostheses are an example of progress in this area.[12] Technology can now supplement the freehand sculpting skills by capturing accurate images of the opposing structures and replicating them in an inverse form.[13]

Digital impression techniques have also been described using sophisticated laser scanning technology. However, the use of magnetic resonance imaging (MRI) and computed tomography (CT) to acquire digital models may expose the patient to unnecessary radiation.[9] Nevertheless, computer

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https://doi.org/10.17159/sadj.v78i02.16165

Figure 1: Frontal and Sagittal extra-oral views of patient.

aided design and rapid prototyping have recently been used to fabricate an inverted copy of an ear.[7] Moreover, there are claims that the application of computer-aided design/computer-aided manufacturing (CAD/CAM) processes can reduce or eliminate errors. With these CAD/CAM processes, some analogue steps are still required.[7,14] More recently, the process of capturing and reproducing a mirror image of a human ear digitally using an intraoral scanner (TRIOS 3, 3Shape) and digital software were explored.[7] In the latter study, Ballo *et al,.*[7] introduced a new technique for direct digital impressions of the ear using the TRIOS 3 intraoral scanner and an external marker as an alternative to the traditional method. The digital scan was performed on a volunteer who had two intact ears and no defect.[7] Although capturing and reproducing an ear has been well described, literature related to the reproducibility of these procedures is limited. Therefore, the aim of this case report is to describe the digital steps taken to ensure a reproducible method in capturing necessary data and fabrication of an auricular template.

Figure 2: TRIOS 3 Basic intraoral scanner.

CASE REPORT

A 34-year-old male was referred to the Maxillofacial Prosthodontic Clinic at Tygerberg Hospital in 2019 for fabrication of a left ear prosthesis (Figure 1). The patient lost his left ear due to trauma. There was no additional damage to the internal ear and the patient's auditory function was unaffected, and he was medically fit.

METHODS AND MATERIALS

1. Digital scanning of the normal ear and affected side with the defect.

A digital intraoral scanner (3 Shape TRIOS 3 Basic, Copenhagen, Denmark) (Figure 2) was used to capture data of both the normal ear on the contralateral side and the affected side in a Standard Tessellation Language (STL) format (Figure 3). The position of an artificial marker (Suremark radiographic stickers, Danville, WA) was placed on the tragus of both the normal ear and the left side of the defect. The tragus was chosen as the landmark for the marker as this was the only anatomical landmark still present on the affected side. The scanning procedure was adopted from the study by Ballo *et al,.*[7]

2. Acquired data processing to produce the inverted copy of the normal ear.

The two STL files were obtained and exported into the Autodesk Meshmixer 3-dimensional (3D) modelling software (Meshmixer v2.1, Autodesk, Inc). The software was used to invert the normal ear on the contralateral side (Autodesk Meshmixer).

3. 3D printing of the ear template.

Once the final design was meshed and the final margins merged with the surrounding area, the design was extracted and imported into a 3D printing machine (Phrozen LCD resin 3D printer). An inverted copy of the normal ear was 3D printed in resin (3D Rapid, Monocure) (Figures 4 & 5). The 3D printed ear template was fitted onto the defect area and photographs were taken to verify the fit and position (Figures 4 & 5).

At this stage, the 3D printed ear template was compared with the template that had been traditionally produced via conventional impression (Alginate, Blueprint, Dentisply) and wsxcarving (Dental modelling wax, Kemdent). Comparison of accuracy fit and anatomic representation was done via direct visualisation of how the different templates fit clinically, photographically and comments from the patients.

No modifications of the digital template were required. The final design of the prosthesis was completed digitally and moulds were designed for the fabrication of the prosthesis which was done manually.

4. Digital skin colour matching & silicon mixing.

An e-Skin spectrocolorimeter and e-Skin calculator[15] was used for colour matching (Figure 6). Three areas on the skin, namely the surrounding area of the defect, the forehead, and the nose, were measured and logged into the e-skin meter. E-Skin uses a digital library of nearly 22,000 skin tones to match to patient skin for prosthetic applications. The e-Skin instrument measures skin colour and instantly retrieves and displays on its screen a matching colorant recipe from its database, or the recipe can be retrieved from the online calculator that also saves the data automatically for future reference. The recipe provides the weights of the Part A and

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Figure 3: Digital scanning of the normal ear and the affected area. STL Files merged using Autodesk Meshmixer software.

Part B Platinum Silicon 511[15] that are required to be mixed with the colours (Figures 7 & 8). The colour was confirmed to match the patient's skin before mixing the silicon.

5. Fabrication of final prosthesis
The mixed silicon and colourants were poured into the mould and which was then invested, processed and the final prosthesis was finished and trimmed. It was then tried on, adjusted where needed and secured in place with medical adhesive (Secure Medical adhesive, Technovent) (Figures 9 & 10). The patient was given home care advice for placement, removal and cleaning of the prosthesis and skin area

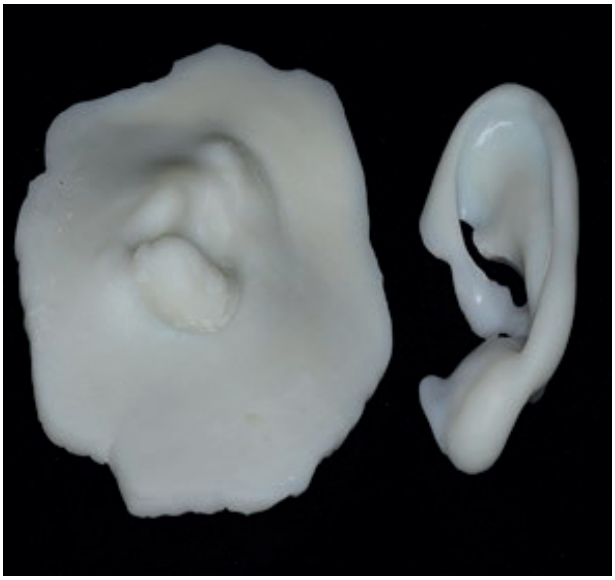
DISCUSSION

Maxillofacial prosthetics is a unique and challenging field in dentistry. Patients afflicted by congenital or acquired maxillofacial defects experience immense psychological anguish as a result of functional and aesthetic deficits. They generally require treatment from a multidisciplinary team in order to select the most appropriate treatment plan, and to execute the rehabilitation in a well-planned and meticulous manner in order to provide them with the best possible functional and aesthetic outcomes. Optimal rehabilitation may be limited by patient-specific issues; however, the main aim is to address both their physical and psychosocial needs and return them to a state of near to normalcy as possible.

Advanced digital technologies (ADTs) at the turn of the millennium showed great promise to the field of maxillofacial prosthetics. The multidisciplinary team embraced ADTs, transforming their approach from an analogue to the integration of such technologies in the rehabilitation of maxillofacial defects. The digital era in which we find ourselves today sees ADTs as securing their place in maxillofacial prosthetics, considerably improving treatment planning and manufacture of maxillofacial prostheses.

This clinical report describes the use of ADT to produce an accurately fitting auricular prosthesis for a patient who lost his ear due to trauma. This technology could decrease the amount of technical skill required to make an ear template. The use of digital software can also decrease laboratory time required and chairside adjustments required.

With the digital scanning phase of the methodology, also known as visualisation or data acquisition, the data of maxillofacial defects may be visualised or acquired by means



Figures 4 & 5: 3D Printed ear.

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Figure 6: E-skin spectrocolorimeter and E-skin Calculator[15]

of medical and non-medical imaging technologies. Non-medical imaging techniques utilising lasers or intense light beams include intraoral scanners, laser surface scanners, and 3D photogrammetry systems.[4,7,16] In this case, the data required to fabricate the ear template was captured using an intraoral scanner (3 Shape). Visualisation may also be accomplished by means of medical imaging including CT, cone beam computed topography (CBCT), and MRI.[7,17]

Unlike non-medical imaging which only captures surface data, the medical imaging allows for deeper visualisation of the defect; thus, both types of data acquisition are sometimes necessary. According to Ballo *et al.,*[7] only a few studies have incorporated intraoral scanners to make a direct impression of maxillofacial defects; this might be due to the difficulty in stitching the captured images from the intraoral scanners due to lack of clear landmarks on extra-oral soft tissues.[7]

However, for other digitising systems, data may be directly saved as a STL. Several types of design software are offered by manufacturers for the design of maxillofacial prostheses with extensive design and sculpting tool sets. This allows the virtual clay models to be sculpted with all necessary anatomical details into any form needed.[18,17] Commercial and open-source software are available. Once the prosthesis is designed it may be saved as a STL file format or matched virtually to the defect model and appraised prior to manufacturing.

Manufacturing is commonly known as 3D printing or rapid prototyping (RP). Azari and Nikzad[19] refer to RP as a "layer by layer technique". This unique layering feature of RP allows for ease of managing formation and production of intricate shapes with internal detail and undercut areas, hence becoming more appealing to prosthodontics. There are several reports in the literature of the efficacy of RP techniques in maxillofacial prosthetics.[20,21,22] These techniques can be used for direct and indirect RP. Direct RP refers to "the process of directly printing out the prosthesis or template", while indirect RP refers to "printing out a mould and manually injecting prosthesis material into it".[23]

The final design of the prosthesis was completed digitally, and moulds were designed for the fabrication of the prosthesis which was done manually. The time reported to design and produce the inverted copy of the normal ear digitally using the Autodesk Meshmixer programme took approximately 30 minutes. The time required for fabrication of the 3D printed ear template was approximately 2.5 hours. This is the main advantage of using this current approach to fabricate an auricular prosthesis, namely the shortened time required for the process. The time[7] Not only does computer-aided design and CAD/CAM significantly reduce the work time but also the number of appointments.[3]

In the current case, data of the normal ear as well as the defect, were successfully captured using the TRIOS 3 Basic (3 Shape) intraoral scanner. The digitized ear was inverted and reverse engineered to fit over the defect. In the Ballo *et al.,*[7] study, the digital scan was performed on a volunteer who had two intact ears and no defect. The scarcity of such case reports was initially referenced in a review by Farook *et al.,*[23], and later, echoed by Suresh *et al.,*[25]. In both systematic reviews, the Balo *et al.,*[7] study was the only study mentioned, that included the use of intraoral scanning technology, while other similar published literature used either desktop type or commercial laser scanners. To date, limited use of intra-oral scanners to fabricate a prosthetic ear/defect has been reported. In this case report, the impression taking process was completely digital. Sykes *et al,.*[26], demonstrated the accuracy of a digitally produced ear template by obtaining ratings from blinded observers and by superimposing the 3Dprinted and wax carved templates over each other and measuring volumetric changes.

Figures 7 & 8: Recipe weight of colouring system and addition of Platinum Silicon Part A and B according to recipe[15]

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Figures 9 &10: Completed adhesively retained prosthesis.

The normal ear on the contralateral side was accurately inverted and merged with the affected side (the negative volume effect) using the Autodesk Meshmixer software. The prosthesis template was successfully printed using a Phrozen 3D printer. The template was tried-in clinically. It fitted accurately and could be reproduced when required. Tam, McGrath and Ho *et al,.*[24] found that out of 6 ear templates produced via indirect processing, 4 of the 6 had good marginal accuracy and retention, while 6 of the 6 showed symmetry and had good position. In this case, although comparison was not the main objective, the clinicians and the patient preferred the 3D printed template over the wax carved template in terms of appearance and accuracy of fit.

CONCLUSION

This case report describes the use of intraoral scanners to make a digital impression and template of an ear for a patient with a missing ear. The TRIOS 3 Basic (3Shape) intraoral scanner successfully captured the anatomy of the normal ear and the affected ear. The 3D printed ear template resulted in an accurate anatomical representation. Two of the authors have clinical experience of fabricating maxillofacial prosthesis using the traditional method with some experience of the newer digital technology as described in this case report. From the successful outcome of this described treatment, they agreed that this digital method is: 1) more accurate; 2) less time-consuming than traditional methods; and 3) less invasive, and thus more accepted by patients. Further exploration of the incorporation and use of digital methods for the full range of maxillofacial rehabilitation is recommended.

ACKNOWLEDGEMENTS

The authors acknowledge the clinical guidance of Drs Sandile Mpungose & Ian Grundling.

No conflict of interest to declare.

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www.sada.co.za / SADJ Vol. 78 No.2
https://doi.org/10.17159/sadj.v78i02.16161

Morphological variations of two cases of maxillary myofibromas

SADJ March 2023, Vol. 78 No.2 p97-100

T Gounden[1], RZ Adam[2], L Mdlalose[3]

INTRODUCTION

The aim of this case report is to depict the varied spectrum of clinical presentation of two cases of solitary myofibromas, one of which was intra-osseous whilst the other presented as a soft tissue lesion. This highlights the spectrum of the clinical presentation of the same pathology.

In the most recent World Health Organisation (WHO) 2022 classification of soft tissue tumours, myofibroma is included under the category of myopericytomas.

Myopericytoma is a distinctive perivascular myoid neoplasm that forms a morphological spectrum with myofibroma. Molecular evidence has revealed PDGFRB (platelet-derived growth factor receptor beta) mutations in myopericytoma and myofibroma as well as SRF-RELA gene fusions in both lesions confirming a common pathogenesis for both.[1]

Myofibromas are benign soft tissue neoplasms derived from myofibroblastic cells.[2]

The term myofibroma refers to a solitary lesion. Myofibromatosis refers to cases in which multiple lesions are present which may affect either one or multiple anatomical locations. Myofibromatosis is almost exclusively seen in young children under the age of 2-years. Myofibromas exhibit a wide age range of clinical presentation and may be present at birth or arise within the first two years of age, but may also present in adults with a significant male predominance. Solitary myofibromas have a predilection to occur in the oral cavity, skin or subcutis of the head, neck and trunk.

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Dr L Mdlalose	Proof read and specialist review	30%

CASE 1

A 12-year-old male patient was referred to the Maxillofacial and Oral Surgery clinic in a central hospital in Kwa-Zulu Natal with no known medical co-morbidities or allergies and a previous history of general anaesthesia for an incisional biopsy of a left maxillary lesion. A 3-year history of a slow growing left maxillary mass causing a left lateralizing zygomatic deformity was reported (Figure 1). There were no palpable lymph nodes in the head and neck region noted on clinical examination.

Computed tomography (CT) (Figures 2&3) and orthopantomography (OPG) (Figure 4), of the facial bones revealed an expansile mass involving the left maxilla/ zygoma complex/ infra-orbital and lateral orbital rims. Histology and immunostaining from an incisional biopsy confirmed a myofibroma. The left zygoma and maxilla was enlarged and firm and the lateral and infra-orbital rim showed signs of expansion. Surgical excision of the mass was completed under general anaesthesia followed by placement of an orbital mesh for globe support and function (Figures 6 & 7).

Figure 1: Pre-operative photograph showing a large left maxillary mass.

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https://doi.org/10.17159/sadj.v78i02.16161

Figure 2: Coronal section of computed tomographic scan showing the circumscribed radiopaque mass located in the left zygoma and maxilla.

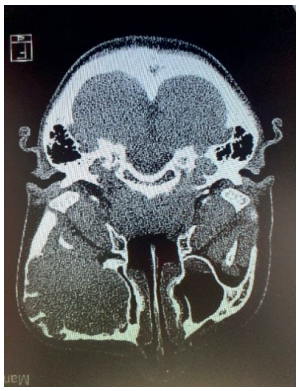

Figure 3: Axial section of computed tomographic scan which highlights the anteroposterior dimensions of the lesion.

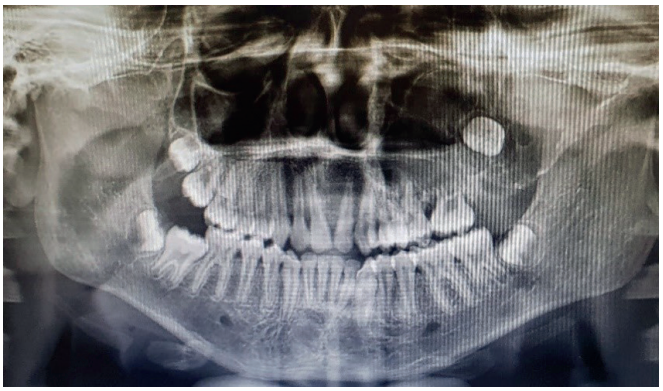

Figure 4: Orthopantomograph illustrating a left maxillary/zygomatic lesion in association with displacement of the posterior molar tooth.

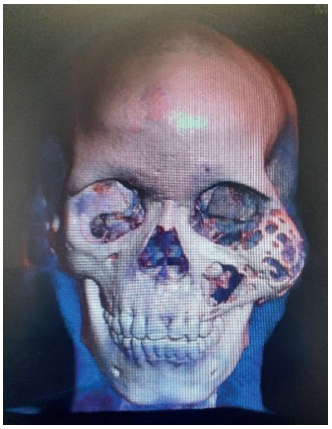

Figure 5: 3D reconstruction of the CT scans which illustrates the borders and extent of the zygomatic/maxillary lesion.

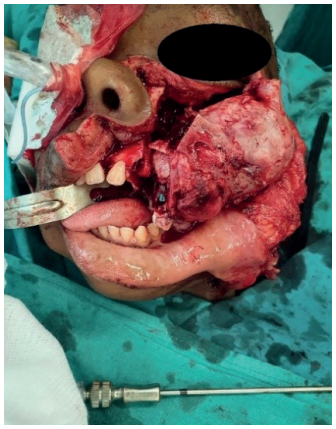

Figure 6: Intra-operative photograph obtained at time of surgical removal of the lesion.

Figure 7: The macroscopic appearance of the excised specimen.

CASE 2 HISTORY

A 64-year-old female patient was referred from Obstetrics and Gynaecology (OBG) to the Maxillo-Facial and Oral Surgery department at a tertiary institution in Kwa-Zulu Natal. The patient presented with a large lobulated mass originating within the oral cavity. Intra-orally, it appeared as a whitish/ grey moveable lobulated mass which was firm in texture on palpation. The lesion appeared to originate from the right maxillary alveolar ridge. The patient's speech was negatively affected. There were no palpable lymph nodes to suggest lymph node involvement. Her main complaint was that she 'couldn't eat or talk properly' due to the size of the lesion, but had primarily come into the hospital due to a left inguinal abdominal pain. She provided a two-year history of recurrence following excision of a smaller lesion in the oral cavity at the same site in 2014. No chronic illnesses were reported, but acute constipation and vomiting was noted in the OBG ward. The patient had no known allergies, was a non-smoker and did not consume alcohol. The patient appeared malnourished on examination.

Plain films revealed no intra-osseous involvement, therefore no specialised radiography i.e., Computed tomography (CT) of the oral cavity was indicated. CT scan of the abdomen revealed an ovarian mass. The oral lesion was removed under general anaesthesia, a simple excision at the base of the lesion was done with a size 15 scalpel blade, a local soft tissue flap was raised to cover the soft tissue defect. Figure 8 shows the lesion in-situ prior to removal and figure 9 shows the excised lesion.

Histopathology and immunostaining revealed features of a spindle cell tumour favouring a myofibroma in the oral cavity. The histopathological diagnosis of the ovarian mass was that of leiomyomata (fibroids). There was no evidence of intra-oral recurrence at 10 month follow up and the patient declined dental rehabilitation. The ovarian lesion was thought to be co-incidental of the oral cavity lesion.

Discussion

Myofibromas occur predominantly in neonates and infants with few reported cases in adults.[3] In a study done by Smith MH *et al.,* 2017 the average age of clinical presentation for myofibromas was shown to be 23.1 years but approximately two-thirds of these tumours were reported to have been noted in the first two decades of life. The age range for myofibromas in this study showed clinical appearance ranging from birth to 84 years of age with a male predilection and a ratio of 1.2:1. The study interestingly also saw that most intra-osseous tumours were found in patients under 20 years and most patients over 40 had myofibromas of moveable tissue which is in keeping with this case report.[2]

Aetiology

Recent literature points to the mutations in the PDGFRB gene that appears to represent a common pathogenesis for myopericytoma and myofibroma.[4]

Myofibromas/ myopericytomas are associated with SRF-RELA gene fusions.

https://doi.org/10.17159/sadj.v78i02.16161

PDGFRB alterations are also seen in sporadic infantile /solitary adult myofibromas,[5] Sporadic infantile myofibromatosis/ myopericytomatosis and conventional myopericytoma.[4]

PDGFRB mutation N666K is noted in myopericytomatosis but not in conventional myopericytoma.[4]

Clinical features

Essential features of myopericytoma include bland, myoid spindled cells growing in a concentric pattern around numerous small blood vessels.

Myopericytoma and myofibroma usually present as a painless, slow growing mass, which can be present for years.[2]

Grossly, most myofibromas are lobulated and on the cut surface there is a white, pink or grey rubbery appearance with whirling and may exhibit a gritty consistency. Displacement of teeth or developing tooth follicles, tooth mobility and/or expansion are seen in some intra-osseous lesions. There are variances in clinical features depending on the site and extent of the lesion.[2]

Clinically the tumour usually presents as a slow growing painless, distinct mass with intact overlying mucosa, however it has been noted that about a quarter of tumours showed rapid growth which may lead to the incorrect diagnosis of a malignancy.[6] A small percentage of tumours do show atypical features and should be diagnosed as such as this is prognostically significant and may increase the risk of recurrence. Malignant transformation of myofibromas has been described previously, however, features of malignancy would be clinically, radiologically and pathologically noted.

Solitary myofibromas have a predilection for the head, while cases of myofibromatosis may involve soft tissues, bones and viscera, typically in the cardio-vascular, respiratory and GIT systems.[7] In the head and neck region, the most frequent site is bone, followed by buccal mucosa and tongue.[1]

Radiology

Intra-osseous myofibromas present as solitary well-defined lesions. Soft tissue lesions may demonstrate focal bone erosion due to pressure effect radiographically.[2]

Haspel *et al.,* 2012 suggests a full body CT with particular attention to the abdomen in order to rule out abdominal or visceral involvement.[8]

In case 2 it is noted that the histology referred to a leiomyomata (smooth muscle origin) for the ovarian lesion, which suggests the ovarian lesion to be unrelated to the myofibroma (myofibroblastic origin).

Histology

Myofibroma and myofibromatosis are histologically identical. Myofibroma is a benign mesenchymal neoplasm composed of myofibroblasts.[8]

Essential features of myofibroma include a biphasic growth pattern with primitive cellular zones often showing mitotic activity, necrosis, calcification and often surrounded by hyalinized nodules of myoid spindled cells.[1]

The centre of the lesion is composed of immature appearing, plump, spindled tumour cells associated with hemangiopericytoma-like branching blood vessels. Periphery of the lesion consists of nodules and fascicles of variably hyalinized, myoid appearing cells.[1]

Lesions are well circumscribed, encapsulated masses of spindled cells, often demonstrating a biphasic or zonal architecture. The periphery of the zones exhibits lighter-stained areas composed of short fascicles or whorls of myofibroblasts with pale pink cytoplasm and long, slender tapered nuclei. Myofibroblasts represent fibroblasts with contractile function and can often be identified by their spindled morphology and dendritic processes. These cells have plump oval nuclei often with open vesicular nucleoli.

The abrupt transition from central to peripheral zones may be an important feature in distinguishing myofibromas from other similar lesions. The central zone demonstrates darker-stained, more cellular areas composed of immature-appearing cells with less cytoplasm and larger, basophilic nuclei. This disease is often misdiagnosed as benign or malignant spindle cell lesions of nerve tissue or smooth muscle origin.

Morphological features of the cellular zones of myofibroma share some features with myopericytoma, suggesting that these are related entities. Myofibromatosis is defined by the presence of multiple myofibromas.[1]

Myofibroma/ myopericytoma with cellular/ atypical features show solid or focally infiltrative growth, increased cellularity increased mitotic activity (more than 10 mitotic figures/ 10 high power fields), areas of infarction type necrosis no pleomorphism and no tumour necrosis.[4]

Figure 8: Pre-operative view of the intra-oral mass arising within the maxillary soft tissue and resultant displacement of the anterior maxillary teeth (case 2).

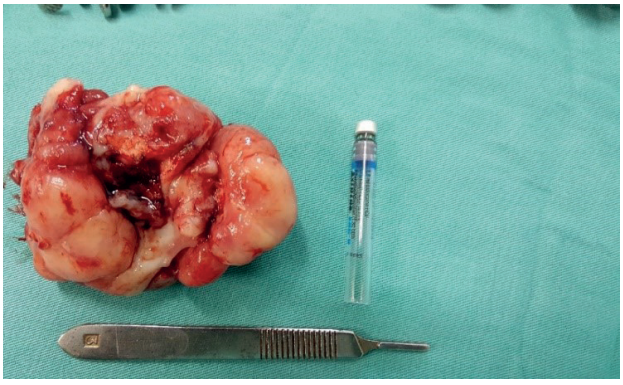

Figure 9: Macroscopic appearance of the fully excised lesion (case 2).

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https://doi.org/10.17159/sadj.v78i02.16161

Pattern of zonation may be more haphazard or even reversed.[9] Mitotic figures are variable in number and cellular zones may undergo necrosis and calcification.[1] In infants, myofibromas may be composed almost entirely of primitive, cellular zones; such cases were historically labelled infantile hemangiopericytoma.[10]

Immunohistochemical staining of cells is required for an accurate diagnosis and in order to exclude similar spindled lesions. Vimentin is the most widely expressed intermediate filament protein thought to be involved in structural processes, however, is not diagnostic for this lesion. Specific markers of myoepithelial cells are alpha-SMA, muscle specific actin, and calponin, and negative markers include CD34, CD31, desmin, keratins and S-100 protein.[2] Mitoses may be identified but are usually sparse. Increased cellularity, increased mitotic activity, cellular pleomorphism, areas of necrosis, infiltrative growth and focally staining perivascular orientation are features suggestive of an atypical myofibroma or malignant myopericytoma.

Differential diagnosis

Includes: reactive fibroblastic/ myofibroblastic lesions (nodular fasciitis, proliferative fasciitis, proliferative myositis), neurofibroma, fibrous histiocytoma, leiomyoma, leiomyosarcoma, hemangiopericytoma/ solitary fibrous tumour, fibromatoses, infantile fibrosarcoma, inflammatory myofibroblastic tumour, desmoplastic fibroma, cranial fasciitis and monophasic synovial sarcoma.[1]

Once the lesional cells react positively to alpha-SMA on immuno-histochemistry the differential diagnoses can be narrowed. Clinical presentation may vary amongst the different pathologies and clinicians should familiarise themselves with key differences in the varying morphologies and histopathology's.

Treatment

Factors influencing treatment include familial history of myofibromas, tumour location, cortical involvement, history of multiple lesions, aesthetic or functional concerns and the age of the patient. Simple excision is mainstay of treatment with local recurrence of 7%-31% according to Beck *et al.,* 1999 however chemotherapy and radiation have been used on recurrent and non-resectable lesions.[11]

Conclusion

In conclusion clinicians must be wary of the array of soft tissue lesions that may present in the oral cavity. This case report highlights the importance of accurate diagnosis via histology with modern day techniques such as immunostaining. It also emphasises the wide age range that solitary myofibromas may appear and its morphological variations. Clinicians must be aware of the morphological similarities between benign and malignant spindle cell tumours as well as the possibility of possible pathologies at other sites of the body.

No conflict of interest

Informed consent taken was for images

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CPD questionnaire on page 108

The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

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https://doi.org/10.17159/sadj.v78i02.16143

What's new for the clinician – summaries of recently published papers (March 2023)

SADJ March 2023, Vol. 78 No.2 P101-104

Edited and Compiled by Prof V Yengopal, Faculty of Dentistry, University of the Western Cape

1. Bleaching efficacy and quality of life of different bleaching techniques

In a world of increasing emphasis on aesthetics and beauty, the tooth form, colour and appearance has taken on significant importance in the overall makeover that many patients seek as part of their quest for beauty and youthfulness. Common concerns among many patients relate to the appearance and colour of their teeth. This dissatisfaction has led to an increased desire for treatments that improve dental aesthetics, including tooth bleaching, which is a conservative and viable option for attaining a patient's desired smile when tooth integrity is acceptable.[1]

Tooth bleaching can be performed at home or in the dental office by a wide range of techniques.[1] At-home bleaching has become increasingly popular since the introduction of the nightguard vital bleaching, which is the most prescribed technique among dentists, mainly due to its high efficacy and safety profile[1]. Although the described protocol for at-home bleaching is the overnight use of a custom tray with a 10% carbamide peroxide (CP) gel (which requires medical prescription), nowadays, several modifications and formulations can be found among manufacturers, with application times ranging between 1 and 8 hours a day.[1]

As an alternative to at-home bleaching, dentists can perform in-office techniques which are viable options typically associated with higher hydrogen peroxide (HP) concentrations. Most of the products have 35% to 40% HP and are available in the form of a base and catalyst gel, either ready-mixed or supplied as a powder/liquid combination to be freshly mixed at the dental office1. The rationale for those higher HP concentrations lies in obtaining faster results, thus being indicated for situations when immediate whitening is required. However, HP's oxidative properties prompted manufacturers and clinicians to search for in-office techniques with lower HP concentrations to prevent hazardous effects on biological tissues. As a result, a wide range of bleaching products with lower peroxide concentrations have been developed over the years, and even an at-home paint-on varnish technique (VivaStyle Paint On Plus, Ivoclar) was proposed for in-office use due to its fast-bleaching rate suggested by a fast HP release in approximately 10 min.[1]

Currently, tooth bleaching is known to potentially influence oral health related quality of life (OHRQoL) by affecting the patient's self-esteem and social behaviours, such as smiling, laughing, or showing teeth without embarrassment.[1] Therefore, the long-term effects of tooth bleaching are not only related to tooth colour stability but may also impact the patient's everyday life.

Pereira and colleagues (2022)[1] reported on a study that sought to compare the bleaching efficacy and oral health related quality of life (OHRQoL) of three different bleaching systems with a similar HP concentration of 6% or its carbamide peroxide (CP) equivalent while assessing the outcomes for up to six months. The following null hypotheses were established: (1) there were no differences in bleaching efficacy between the three tested bleaching systems; (2) there were no differences in tooth colour stability, at the six-month follow-up, between the three tested bleaching systems; (3) there were no differences in OHRQoL, at the end of treatment, between the three tested bleaching systems; (4) there were no differences in OHRQoL, at the six-month follow-up, between the three tested bleaching systems.

Materials and methods

This randomised clinical trial had three parallel groups (30 per group; 90 patients in total) corresponding to different products and techniques: group A, in-office paint-on varnish 6% HP (VivaStyle Paint On Plus); group B, at-home 6% HP with a prefilled disposable tray (Opalescence GO); group C, at-home 16% CP with a customised tray (Opalescence PF 16% CP).

Participants attending the faculty clinic were screened according to the following inclusion criteria and consecutively recruited: being at least 18 years of age, having the upper canines darker than A3.5 in VITA Classical (VC) shade guide (assessed by spectrophotometry), accepting to interrupt smoking habits during the full duration of the study, and signing an informed consent form. The exclusion criteria were the presence of fixed orthodontic appliances, decayed teeth, pregnancy, poor oral hygiene, anterior teeth (16 anterior teeth, from the second premolar to the second premolar) with dental restorations, endodontic treatment, and severe anomalies of the dental structure or intrinsic stain.

Each bleaching system was coded from A to C using a randomisation software. A third party (blinded to the allocation results) analysed the data in an SPSS worksheet where each bleaching system was referred to as groups A to C.

Participant and clinical operator blinding was not possible due to the three whitening systems' different formulations. However, the tooth colour examiners were blinded, and spectrophotometric analysis was recorded as per machine output, thus reducing the potential bias.

Examiners were calibrated, and during the study, if disagreements occurred, the examiners reached a consensus. To standardise lighting conditions, the Smile Lite device (Smile Line) with LED lights at 5500 K and a polarisation filter was used.

An independent and blinded examiner performed objective tooth colour measurements with a spectrophotometer (SpectroShade micro (SS).

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The validated Portuguese version of the Oral Health Impact Profile 14 (OHIP-14) was applied at baseline, at the end of treatment (after bleaching), and after six months (six-month follow-up. The questionnaire consisted of 14 questions with seven domains (two questions per domain): functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. The answers were scored according to a Likert scale from 0 to 4 (never = 0, rarely = 1, sometimes = 2, repeatedly = 3, always = 4), with higher scores representing a worse OHRQoL (OHIP-14 total score ranged from 0 to 56 and each domain score from 0 to 8). Effect size (ES) and standardised response mean (SRM; calculated by dividing the mean score change by the standard deviation of the change) were calculated and ES and SRM were described as small < 0.3, moderate 0.3–0.8, or large ≥ 0.8 effect). A minimal important difference (MID) of five in the total OHIP-14 score change was also considered.

For the clinical procedures, In the first appointment, each patient was screened at the first appointment according to the inclusion/exclusion criteria and submitted to professional dental prophylaxis with interproximal radiographs for diagnosis purposes. The professional dental prophylaxis was performed using an ultrasonic scaler and a nylon brush with prophylaxis paste in a low-rotation contra-angle handpiece by a dentist. Each patient was assigned to one group, according to the randomisation process. One week after, the clinical bleaching protocol was performed according to the technique's description which was done according to manufacture's recommendations.

To assess tooth sensitivity that could lead to treatment interruption, all patients were instructed to fill a daily visual analogic scale (VAS) form during the treatment (15 days), numbered from 0 (no pain) to 10 (maximum extreme pain), while notifying medication intake and oral lesions occurrences. Additionally, instruction forms were delivered with information regarding at-home bleaching procedures, food intake (to avoid acidic and potential staining foods), and oral hygiene. Patients were instructed to use their regular toothpaste during the whole study to avoid any potential change in tooth sensitivity unless it was a whitening toothpaste, in which case they were instructed to change to a non-whitening 1450-ppm fluoride-containing toothpaste.

Tooth colour measurements were performed at baseline, after bleaching treatment, and at the six-month follow-up. The colour of the upper central incisors and canines' buccal surfaces was assessed with the VC and VB shade guides with the patient seated on the dental chair while the calibrated examiner used the Smile Lite device with LED lights at 5500 K and a polarisation filter for standard lighting conditions. The shade tabs received a number to categorise each colour: VC tabs were numbered from 1 to 16 according to the colour's value order from the highest (B1) to lowest (C4), and VB tabs were also numbered according to the colour's value order from 1 to 15 (highest: 0M1; lowest: 5M3). The total tooth colour difference (ΔE00) and tooth whiteness index (WID), with the corresponding difference (ΔWID), both based on the CIE L*a*b* colour notation system, were calculated to evaluate bleaching efficacy at the end of treatment and colour relapse at the six-month follow-up.

Results

Ninety participants were included in the study after the recruitment procedures: 56 females and 24 males, aged between 18 and 40 years old with a mean of 23.0 [22.8:23.4] years. A total of 80 bleaching treatments were completed (group A: 27; group B: 26; group C: 27) with an overall 11.1% attrition rate bias due to COVID-19 quarantine measures, leading to an overall 32.2% attrition bias at the six-month follow-up (group A: 20; group B: 20; group C: 21). Baseline CIE L*a*b*, WID, and shade guide unit (SGU) values and did not show significant ($P > 0.05$) differences between groups, resulting in tooth-colour and whiteness homogeneity before bleaching treatment.

Bleaching efficacy analysis detected that the perceptibility thresholds in all techniques were surpassed in at least 98% of cases and attained 100% in the upper canines (98% for acceptability thresholds). Thus, all techniques showed bleaching efficacy even though the ΔE00/ΔWID/ΔSGU were significantly higher ($P < 0.05$) in group C after bleaching. The L* colour coordinate presented significantly ($P < 0.05$) higher mean values while a* and b* were lower when compared to baseline, indicating a lighter and less yellow tooth colour post-treatment. The WID mean values were significantly ($P < 0.05$) higher after bleaching in all groups, thus indicating increased levels of whiteness in tooth colour. The SGUVC and SGUVB mean values were significantly ($P < 0.05$) lower after bleaching, indicating that the examiners detected higher value colour tabs.

At the six-month follow-up, an inverse response was detected in all variables, with values becoming closer to the respective baseline. All techniques showed colour stability even though tooth colour relapse cases were higher in group C (83.3% cases).

There were no reports of treatment interruption due to tooth hypersensitivity or presence of oral lesions, with the overall VAS mean values between the three groups similar, without significant ($P > 0.05$) differences.

There was a noticeable improvement in OHRQoL after tooth bleaching, represented by significantly lower ($P < 0.05$) OHIP-14 total score values when all treatments were considered. However, no significant differences ($P > 0.05$) in OHIP-14 scores were detected within or between groups, indicating that changes in OHRQoL are not related to the bleaching technique.

Conclusions

The researchers concluded that all techniques presented bleaching efficacy, colour stability, and improvements in ORHQoL up to six months post-treatment.

Implications for practice

Clinicians may consider both at-home and in-office bleaching techniques with 6% HP to attain long-lasting satisfactory clinical results while producing positive changes in ORHQoL.

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https://doi.org/10.17159/sadj.v78i02.16143

1. Do different placement techniques for composite resins affect clinical success in Class II cavities?

Composite resin fillings are routinely used in posterior restorations and have almost completely replaced amalgam fillings as the material of choice. In many clinical cases, polymerisation shrinkage and the limited polymerisation depth of most conventional composites are prevented with the use of thinner composite layers.[1] Traditionally, the resin composites are placed in increments of 2 mm (maximum) that are cured separately (incremental technique)1. This incremental technique provides sufficient light penetration and monomer conversion. However, it has disadvantages such as the risk of blood or saliva contamination between layers, bonding failures, and time-consuming protocols, and it is difficult to apply in large cavities. There are various benefits to bulk-filling of the cavities: it is more time-efficient and can avoid technical errors such as voids and contamination between layers.

Polymerisation shrinkage is one of the major disadvantages of conventional resin composite restorations. It has been associated with marginal insufficiencies, cracked cusps, cuspal movement, and enamel fractures, which may result in microleakage, postoperative sensitivity, and secondary caries1. Shrinkage stress is influenced by tooth-related variables such as cavity size and configuration factors (C-factor). Cavities with a high C-factor will cause greater stresses owing to a greater number of bonded surfaces.[1]

The most important factors that affect it are volumetric shrinkage of the restorative material and elastic modulus. In resin composites with a lower modulus of elasticity or a slower curing rate, lower polymerisation stress may occur.[1] However, these properties are often inversely proportional to each other and largely depend on the amount, size and shape, monomer structure, or chemistry of filler particles. Another important parameter for resin composite restoration is the depth of cure. Resin composite contains a photo-initiator that is triggered by blue visible light to activate the polymersation.

Many resin composites contain camphorquinone as a primary photo-initiator and a tertiary amine as a co-initiator1. In addition, photo-initiators such as trimethyl benzoyl diphenylphosphine oxide (TPO) and dibenzoylgermanium (Ivocerin) derivatives have also been used.[1] Various strategies have been developed by manufacturers to increase the depth of cure. In particular, extensive efforts have been made with new monomers, initiator systems, and filler technology; translucency was also increased for better light penetration and polymerisation. Based on these, manufacturers have presented to the market “bulk-fill composites” that can be polymersed in a single layer up to 4–5 mm thick. A material that is presented to the dental market is primarily evaluated in vitro conditions that simulate the oral environment. Nonetheless, clinical trials are needed to clearly determine the clinical properties of the materials. Kılınç & Demirbuga (2022)[1] reported on a trial that sought to evaluate the clinical success of bulk-fill resin composite positioned through different placement techniques (bulk-filling and incremental techniques) in Class II carious lesions using the criteria of the World Dental Federation (FDI) and the United States Public Health Service (USPHS). The tested null hypothesis was that “Placement techniques do not have a significant effect on the clinical success of bulk-fill resin composites.”

Materials and methods

This was a randomised, double-blind, and split-mouth clinical study. A total of 158 volunteers aged 18–22 years (the mean age of the participants was 19.2 years) with similar oral hygiene (none of the patients had gingivitis and periodontitis in the gingival health assessment), and similar oral hygiene habits (they had all brushed their teeth at least twice a day), and were inspected by two pre-calibrated dentists. Evaluations were made under reflector light using a mouth mirror, explorer, and periodontal probe. Using the inclusion–exclusion criteria and radiographic findings, 20 participants (12 females, 8 males) were included in the study. Patients were included if they had least, 4 Class-II caries lesions in first and second molar teeth (MO or DO); Good health systemically; An acceptable level of oral hygiene; Teeth with occlusal and proximal contact and were 18–20 years old. Those that had deep caries lesions reaching the pulp, bruxism, periodontal disease or secondary caries were excluded.

Four restorations (two bulk-fill resin composites that had different placement techniques (bulk-filling and incremental technique)) were placed randomly. In the present study, two different bulk-fill resin restorative composites (X-tra fil and Filtek Bulk) were used in the bulk-filling and incremental technique. The bulk-fill resin composites were used in both the bulk-filing and incremental techniques for the same participant. The study consists of 4 groups and 20 restorations in each group (80 restorations in total).

Cavities were prepared by a single dentist using a standardised protocol that included the use of rubber dam and did not exceed a depth of 4mm. A one-step universal adhesive system (Clearfil Universal) was used for the self-etch mode following the manufacturer’s instructions After bonding procedures, the groups were created as follows.

1. X-tra fil (bulk-filling) (X-traB)
2. X-tra fil (incremental) (X-tral)
3. Filtek Bulk (bulk-filling) (FBB)
4. Filtek Bulk (incremental) (FBI)

For the incremental technique, the cavities were filled horizontally in two pieces with a 2mm thickness of each layer. For the bulk technique, one layer (approximately 4mm) was applied in bulk. An LED light device (Valo, 1000 mW/cm^2) was used for the cure of the restorations according to the manufacturer’s recommendations (10s for X-tra fil, 20s for Filtek Bulk Fill). Diamond burs and sanding paper were used to finish and polish restoration.

Clinical evaluations of the restorations were done baseline, sixth-month, second-year, and fourth-year using FDI and USPHS criteria, by two calibrated scorers. The scorers were blind to the group assignment because they were not involved in the restoration procedures. In a double-blind randomized clinical trial design, subjects were likewise kept in the dark regarding their group assignment. In case of inconsistencies between scorers, the restorations were re-evaluated by two examiners and a final consensus was reached. The resulting data were recorded in the standardised case report form.

Evaluations of postoperative sensitivity were made seven days after restorative procedures by asking the patient about the effect of occlusal force (chewing) and cold/hot

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stimuli. To detect secondary caries after four-year, bite-wing radiographs were taken. On the scales employed in the study, each criterion was assessed independently. It describes the characteristics of a clinically acceptable restoration on both scales. For each criterion, there are three scores ("alpha" for an ideal clinical condition, "bravo" for clinically acceptable condition, and "charlie" for clinically unacceptable condition.) in the USPHS and five ("clinically very good", "clinically good," "clinically sufficient/ satisfactory," "clinically unsatisfactory," "clinically poor") in the FDI. In the USPHS criteria, regardless of the severity of postoperative sensitivity, when postoperative sensitivity was determined, it was evaluated as "charlie," and in the absence of postoperative sensitivity, it was evaluated as "alpha." Secondary caries was scored in the same way.

Results

All restoration was evaluated at baseline, six-month, two-year, and four-year recall. According to both criteria used in the current study, all 80 restorations of the 20 participants were evaluated without any loss.

Eight restorations (three restorations in the FBB group, four restorations in the FBI group, and one restoration in the X-tral group) were broken at the end of year four. There was no loss of any retention after four years. At the end of four years, the groups showed no statistical difference between the baseline and the four-year findings ($P > 0.05$). When the groups were evaluated among themselves, there were no statistically significant differences in the four-year recall ($P > 0.05$). Postoperative sensitivity was not detected in any restoration after year four. The difference between the groups was not statistically significant at the baseline evaluation ($P > 0.05$). For all of the variables assessed: Marginal adaptation, Marginal discoloration, Secondary caries, Anatomical form and Colour match/ staining surface, there was no significant differences between the groups at the four-year recall.

Conclusions

The researchers concluded that there were no differences observed between the bulk-filling and incremental techniques at the end of four years.

Implications for practice

The longer term (four years) clinical success bulk-fill composites is not dependent on the placement technique used.

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Online CPD in 6 Easy Steps

The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

www.sada.co.za / SADJ Vol. 78 No.2
https://doi.org/10.17159/sadj.v78i02.16149

Are you responsible and accountable for your actions?

SADJ March 2023, Vol. 78 No.2 P105-106

LM Sykes [1], S Shaik[2], C Bradfield[3]

ABSTRACT

In all walks of life we are accountable for our actions. However in dentistry the scope and extent of one's responsibilities may not always be obvious. This paper aims to remind clinicians of their need to be cognisant of some fundamental principles, and to ask themselves certain relevant questions before embarking on any procedure. It makes special reference to the obligations associated with the increased use of dental imaging modalities. It does not purport to be a comprehensive review into any specific dental condition or treatment modality, but is rather a broad overview and reminder of their ethical obligations with respect to their "duty of care".

Introduction

Before embarking on any dental procedure or intervention clinicians needs to consider a number of patient, personal, and procedure –related factors, to ask themselves certain questions, and to plan the way forward in a way that will be in their patients' best interest.

Steps, questions and considerations

1. The first consideration is "Why has the patient come in?" They may present with pain, sepsis, traumatic injuries, ill-fitting prostheses, broken restorations, old and unsightly prostheses / restorations, suspicions of dental or oral disease, for a routine check-up, for oral hygiene maintenance, with aesthetic demands, or asking for certain specific treatment. This should be noted and documented using the patient's own words as well as how it was observed and interpreted.

2. The second question is to try and elicit what the patient wants and if they are only interested in immediate care or are also looking for future treatment. They may desire any number of procedures such as: oral hygiene prophylaxis, pain relief, elimination of infection and sepsis, a simple isolated procedure such as an extraction or minor restoration, denture easing, a denture reline / repair, appliance adjustment, fixed crown and bridge work, implant therapy, temporomandibular joint related therapy, help with other oral issues such as xerostomia, altered taste, burning mouth or suspected malignancy, jaw-wiring for weight loss (A topic for a future ethical debate), and treatment of traumatic injuries. Patients generally have very specific desires that may not necessarily be the same as, or encompass all of their actual needs. It is wise for clinicians to accede to their autonomy and address the former and then try to educate them into appreciating the need for the latter.[1] Many Health Professions Council (HPCSA) complaints stem from mis- communication and fee disputes rather than actual treatment related unhappiness.[2-5]

3. The third step is for the dentist to decide on what is needed initially and may require actual direct "hand-on" action or could involve carrying out other adjunct procedures. If the patient is in pain, has active infection / sepsis, or has suffered from a traumatic injury, they will need immediate pain relief and infection control. Procedures such as denture easing / repairs, prosthesis adjustments, placement of tissue conditioners, implant screw tightening or component replacements, are also examples of procedures that can be carried out at the first visit. However initial interventions may also include taking radiographs, impressions for study models, smears, biopsies, or blood tests or any other procedure deemed necessary to make a diagnosis and formulate a comprehensive treatment plan.

4. The fourth consideration is probably the most crucial, and where ethical issues may arise. It behoves the clinician to take a holistic approach and together with the patient, discuss the ideal long term treatment plan and goals.[1] It would be irresponsible, unethical and even at times, negligent to only focus on the first three issues and not have a long-term strategy in mind. Granted there may be rare occasion where no further treatment is warranted, however, this is seldom the case, as most patients will benefit from even basic, regular maintenance therapy. This will involve carrying out treatment according to the proposed plan, referral to other colleagues if more complex procedures are needed, and long term monitoring and maintenance.

ETHICAL ISSUES RELATED TO DIAGNOSTIC IMAGING

The field of diagnostic imaging has, and continues to advance at an extraordinarily fast rate. Newer, faster, more accurate, detailed and in-depth, and less invasive machines and techniques continue to come onto the market. These range from the well-known dental imaging modalities and views such as periapical radiographs,

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www.sada.co.za / SADJ Vol. 78 No.2
https://doi.org/10.17159/sadj.v78i02.16149

panoramic images, extra oral skull views, to the more complex Computed Tomography (CT), Magnetic resonance Imaging (MRI), Ultrasound (US), and Cone Beam Computed Tomography (CBCT).

Before any clinician takes any image they need to be able to answer all of the following questions in the affirmative in keeping with the primary principles of justification, dose optimization and dose limitation:

- Have I ascertained if the patient has had any images taken in the recent months that could still be used?
- Is it necessary to take any images in order to see the area of interest better and / or to carry out the required treatment?
- Will this image add new information or alter the diagnosis/treatment plan?
- Is there an option for non-ionizing radiation?
- Is this the best image to take in order to make the most accurate diagnosis?
- Will this image expose the patient to the least amount of radiation?
- Do I know the exact dose of exposure that this image will inflict on my patient, and have I ensured that I am not exposing them to dangerously high dosages?
- Am I aware of the indications, advantages and limitations with this particular imaging modality and am I still confident it is necessary / the best option?
- Is the patient aware of the costs and risks associated with talking this image?
- Has the patient consented to have this image take?
- Is my equipment functioning optimally in order for it to take the best image possible?
- Am I and my staff protected from scatter radiation when I am taking this image?
- Am I capable of interpreting the findings of this image?
- Do I have the necessary anatomical knowledge to be able to identify all the landmarks that will be evident in this image?
- Do I have the necessary radiological and pathological knowledge to be able to identify abnormalities, inconsistencies, and pathology in this image?
- Have I been trained to identify any and all other features or incidental findings within the entire field of view of this image?

These questions are crucial to guide the practitioner to justification and optimization and help to reduce risks of unnecessary or excessive patient exposure. In depth and basic principles that guide CBCT 'best practise' can be found in the latest version of SEDENTXTCT. [6]

Any person who takes any image is liable to examine it in its entirety (not to only look at their area of interest) and to report on findings from the entire field of view. Failure to detect and manage any pathology is considered negligence and is grounds for litigation. It is alleged that some practitioners expose a large area of the head or jaws and reduce the reconstruction to a small field of view and do not consider the rest of the view their responsibility. The practitioner who referred, the one who exposed, and the one who interpreted are all equally liable.

Any practitioner that engages in radiology beyond conventional 2D imaging is required to undergo additional theoretical and practical training, preferably in an academic institution.[6,7] This should cover the fundamentals of anatomy and pathology of the jawbones and all structures visible within the confines of the cross sectional data.[7] If a complex diagnostic image is deemed necessary and extends beyond the jawbones, the practitioner is duty bound to rather refer the patient to a trained radiologist who will be able to provide them and the patients with the most accurate and detailed report. Furthermore it is morally and ethically deplorable to expose any patient to unnecessary imaging merely to offset the expense of having purchased the machinery.[8]

Bear in mind that the concept of 'retrospective litigation' is real and going to gain popularity in this country.

Legal requirements

The licence holder of any x-ray machine is responsible for radiation safety, fulfilment of all statutory requirements and compliance to the Act's, Regulations and Conditions of that license. Part of which is to have a running and monitored Quality Control (QC) program and as stipulated, ensure radiation exposure is kept as low as reasonably achievable (ALARA) without compromising diagnostic efficiency. Mandatory records must include patient demographics, date of examination, clinical indication, type of examination, number of exposures and repeat exposures, name of practitioner, total Dose Area Product (DAP) if applicable, and importantly the diagnostic information obtained from the examination.[9]

Conclusion

Before embarking on ant treatment an ethical and professional practitioner needs to take the time to consider patients in a holistic manner that includes both their current and anticipated future treatment needs. At the same time, patients should be educated and empowered to make mutual decisions with regards to the diagnostic, planning, and execution of any treatment. Thereafter the care provided should be tailored and appropriate to their individual desires and needs, time and financial constraints and within the scope, training, and capability of the service provider.

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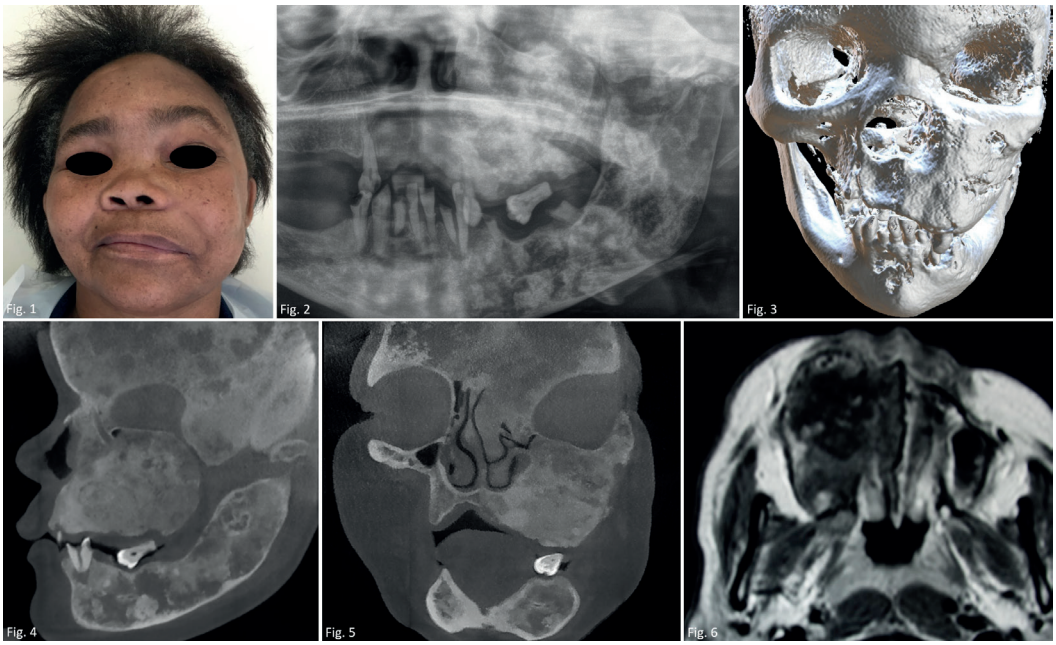
https://doi.org/10.17159/sadj.v78i02.16171

Oral and Maxillofacial Radiology

SADJ March 2023, Vol. 78 No.2 P107

J Walters[1], S Indermun[2]

This 40-year-old female presented for extractions of mobile teeth. A bony hard mass affected the left side of the face. She reported being blind and deaf on the affected side. What is your diagnosis?



INTERPRETATION

Clinically *(Figure 1)* a unilateral swelling, proptosis and obliteration of the nasolabial fold was noted. Intraoral examination revealed normal-appearing overlying mucosa. A pantomograph *(Figure 2)* demonstrates a mixed diffuse expansile lesion and thinning of the cortices affecting both jaws. 3D reconstruction *(Figure 3)* overview the lesions' extent. CBCT interpretation *(Figures 4 and 5)* indicated engrossment of the frontal, parietal, temporal, sphenoid, ethmoid, maxillary, palatine, zygomatic, and mastoid bones. T1-weighted gadolinium-enhanced MRI image (Figure 6) of a patient with a similar lesion in the right maxilla demonstrates a heterogeneous appearance. Fibrous dysplasia (FD) is an uncommon benign non-neoplastic developmental bone disease of fibro-osseous origin. In accordance with which normal medullary bone is replaced by fibrous tissue. Variants are defined as monostotic (MFD), affecting one bone, polystotic (PFD) multiple, and craniofacial includes the head-and-neck only. Association with McCune-Albright syndrome (MAS) is well documented.[1] The mean age at the time of diagnosis is 25 years. Onset of PFD ranges from 3 months old in precocious puberty to late 60s in adults. Sex prevalence expressed (male:female) as 1.6:1 (MFD), 1.2:1 (PFD), and 9.4:1 in craniofacial.[2] The femur, jaws, skull, and ribs are typically affected. Predilection for the maxilla is approximately double compared to the mandible. Affected sites present painless, progressively enlarging, bony lesions with marked unilateral tendency. Facial asymmetry, malocclusion, and teeth spacing may occur in the jaws. Pigmented skin lesions (café au lait macules) can be observed in MAS.[3] Radiographic presentations consist of three distinct patterns. Pagetoid features mixed densities; sclerotic as homogenous “ground glass”; and cyst-like with oval lesions accompanied by sclerotic borders. Indiscernible merging with adjacent bone occurs as lesions mature. Radiation treatment is contraindicated due to documented sarcomatous changes. Differential conditions include ossifying fibroma, Paget disease, florid osseous dysplasia, and osteopetrosis.[4]

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CPD questionnaire

An innovative digital workflow for the fabrication of a prosthetic ear: A case report

1. Select the CORRECT option. STL is an acronym for…

A. Standard Tessellation Language
B. Standard Tracing Level
C. Standard Technical Language
D. None of the above are correct

2. Choose the CORRECT answer. What scanner was used to obtain digital impressions of the patient's normal ear and the defect on the affected side?

A. TRIOS 3
B. PrimeScan
C. OmniCam
D. CadCam

3. Choose the CORRECT answer. What was the time required for the fabrication of the 3D printed ear template?

A. 4 Hours
B. 3 Hours
C. 2.5 Hours
D. 1 Hour

Neoplastic tissue transfiguration in vivo by recombinant human transforming growth factor-β3

4. Select the CORRECT statement. Which of the following statements are CORRECT regarding human transforming growth factor-β3.

A. In this study, implanted mice had a very low mortality rate.
B. Experimentation in the Chacma baboon, Papio ursinus, has shown that the recombinant human transforming growth factor-β3 (hTGF-β3) is the most powerful osteoinductive morphogen so far tested in primates.
C. Transplanted cells from human oral squamous cell carcinomas into had no effect on mice in this study.
D. None of the above

Perceptions of oral health practitioners regarding the long-term effects of service learning; a qualitative study

5. Which is the CORRECT answer. The researcher studied postgraduate officers from:

A. 1994-1996
B. 2019-2021
C. 2015-2017
D. 2000-2003
E. 2020-2022

6. Select the CORRECT option. Which of the three study programs had the most participants?

A. BOH
B. BDT
C. BDS
D. All had an equal allocation

7. Which of the following is CORRECT. The methods for the study included

A. English as the language of use.
B. Student interviews.
C. Focus group discussions.
D. Analysis of the influence of service-learning on students, faculty, and community.
E. A three-part, semi-structured questionnaire.

8. Select the CORRECT statement. Of the themes that emerged from the data analysis was:

A. Emotional intelligence
B. Personal qualities
C. Quality of Life
D. Intelligence quotient
E. Inter-personal relationships

9. Which of the following statements is INCORRECT. The study recommended the following, except:

A. Benchmarking.
B. Proper delivery of the service-learning content.
C. Qualitative research, exploring the strengths of service learning.
D. A scholarship of engagement to link theory and practice, as well as cognitive and affective learning.
E. Evaluation of the pedagogy by community partners.

Supernumerary teeth in a sample of South African dental patients.

10. Choose the CORRECT answer. The prevalence of SNT in the South African population is:

A. 2.48%
B. 2.7%
C. 6.7%
D. 13.1%

11. Choose the CORRECT answer. The distribution of SNT in the anterior premolar and molar regions in the South African Sample demonstrated:

A. A high number of SNT in the mandibular anterior region compared with the maxillary anterior region
B. A high number of SNT in mandibular premolar region compared with the maxillary premolar region
C. A low number of SNT in the maxillary molar region compared with the mandibular molar region
D. An equal distribution of SNT in both the mandibular anterior and molar region

12. Which of the following options is CORRECT. In this retrospective study done on South Africans, the majority of SNT belonged to the morphological category of

A. Supplemental
B. Odontoma
C. Conical
D. Tuberculate

13. Choose the CORRECT answer. The SNT research project found the following result:

A. The variation in eruption status and morphology of SNT was statistically insignificant
B. The variation in the region-wise distribution of SNT in the maxilla was statistically significant
C. The variation in the region-wise distribution of SNT in the mandible was not statistically significant
D. Spacing of teeth in the presence of SNT was a significant finding

14. Choose the CORRECT answer. Complications associated with SNT in the premolar region are mainly

A. Difficulty in closing extraction spaces during orthodontic tooth movement
B. Problems in placement of mini-implants for additional anchorage
C. Hinderance to orthodontic tooth movement
D. All of the above

Evidence Based Dentistry:

15. Which of the following statements is CORRECT. In the Pereira *et al,.* trial, the attrition rate at 6 months recall was

A. 0%
B. 11.2%
C. 20.3%
D. 32.2%

16. Select the CORRECT finding. In the Pereira *et al,.* trial, findings show

A. At the 6-month follow-up, only group A & B showed colour relapse
B. At the 6-month follow-up, only group A & C showed colour relapse
C. At the 6-month follow-up, only group B & C showed colour relapse
D. At the 6-month follow-up, all groups had some measure of colour relapse.

17. In the Kılınç & Demirbuga trial, which of the following statement is NOT CORRECT

A. The examiners who assessed the filling were blinded
B. The patients were blinded to the filling technique
C. The dentist who placed the filling was blinded to the technique
D. The examiners were blinded to the material used.

18. Select the CORRECT option. In the Kılınç & Demirbuga trial, which of the following finding is correct:

A. Restorations using X-tra fil (bulk-filling) has better anatomic form that the other groups
B. Restorations using Filtek Bulk (bulk-filling) had lower secondary caries rates that the other groups
C. For all of the variables assessed, there was no significant differences between the groups at the 4-year recall.
D. Restorations with X-tra fil (incremental) has the highest post-operative sensitivity rates.

Radiology Corner

19. Choose the CORRECT option: Fibrous dysplasia is considered to be a:

A. Developmental disease
B. Benign true neoplasm
C. Hamartomatous lesion/malformation
D. Non-odontogenic neoplastic lesion

20. Choose the INCORRECT answer: Fibrous dysplasia variants include:

A. Monostotic
B. Craniofacial
C. Polystotic
D. McCune-Albright

Ethics: Are you responsible and accountable for your actions?

21. Before embarking on any dental procedure a clinician should:

A. Devise a short, medium and long term treatment plan
B. Elicit what the patient wants and do only that
C. Elicit both the patients desires as well as their identified needs
D. Only a and c are correct
E. Only a and b are correct

22. In the interests of beneficence and patient autonomy the dentists should:

A. Carry out procedures that the patient requests
B. Carry out procedures that they feel are in the patient's best interest regardless of their desires
C. Try and educate the patient into accepting procedures that are in their best interest
D. Charge more if they have to carry out procedures they do not agree with

23. Which of the following is correct

A. Patients seldom lodge complaint to the HPCSA on issues other than bad treatment and high costs
B. Even if only emergency work is to be done the dentist should consider future treatment needs
C. It is not necessary to take radiographs when treatment involves mere pain relief or control of sepsis
D. It is not in the scope of practice for dentists to take biopsies or blood tests
E. A dentist may refuse to treat a patient with sepsis if the patients is not one of their regular patients

24. With regards to dental imaging, a dentist should:

A. Always take some form of dental image to confirm their diagnosis
B. Take new images at every visit to avoid supervised neglect
C. Record only the number of useable images taken and only charge for these
D. Record the number of all images taken
E. Both A. and D. are correct

25. Which of the following statements are correct

A. Dentists are only obligated to interpret findings within their field of interest
B. It is up to each staff member to protect themselves from scatter effects of radiation
C. Practitioners who are not confident of their abilities to interpret a full field of view should rather reduce the reconstruction to a smaller field that they can interpret
D. Failure to detect and manage any pathology is considered negligence
E. If a practitioner refers a patient then only the person who exposed is liable for its interpretation.

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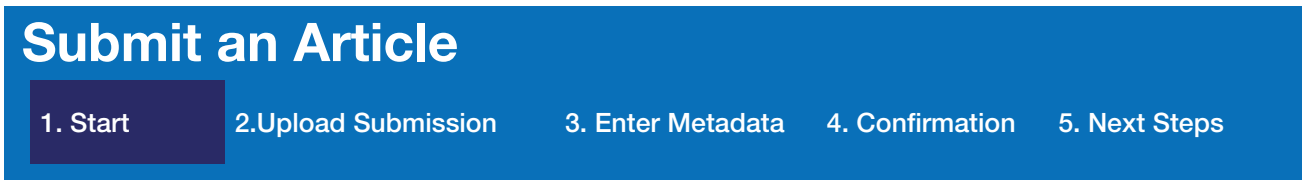

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